[ESTABLISHED 1882]
THE OLDEST RAILROAD JOURNAL IN THE WORLD

AMERICAN ENGINEER AND RAILROAD JOURNAL.

PUBLISHED MONTHLY
BY
R. M. VAN ARSDALE, INC.
140 NASSAU STREET, NEW YORK

J. S. BONSALL, Vice-President and General Manager
F. H. THOMPSON, Advertising Manager.

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V. C. JONES, Western Representative
407 Medinah Bldg., Chicago

JULY, 1911

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CONVENTION NOTES

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The report of the committee on mechanical stokers before the M. M. Association brought out a very general and important discussion. It was clearly shown, as has been pointed out in these columns previously, that mechanical stokers will successfully fire a locomotive and are doing so at many different points. While this is most gratifying, it was shown that in at least one case a stoker which would successfully fire when in operation had been discarded because of lack of reliability. This important feature, together with information on methods of caring for the stoker and maintaining it, received surprisingly little comment. It is apparently too early in the experience of most members to discuss these features, which will eventually determine the continued use of different designs. In connection with fuel economy, so far as the amount of fuel used is concerned, the discussion showed that little can be expected when compared with the best hand firing. It was indicated, however, that considerable economy could be obtained by the successful use of lower grade and cheaper fuels.

The paper on superheating by Professors Benjamin and Endsley added a very important chapter to the most valuable volume of information which is being produced by the laboratories of Purdue University. The tests throughout showed conclusively what had already been claimed by many experts, that it is the higher degrees of superheat which give the real economies, i. e., the economy increases at a greater ratio than the degree of superheating, and so far the tests have not discovered the limits to this condition. The conclusive settlement of this point will be no doubt most gladly received by the motive power officials. Testimony of the members indicated wonderful results with superheat and the indications are that like all other appliances of advantage or economy after their value has been conclusively proven, superheat will be very rapidly and generally used throughout the country.

In the discusison of the paper on "Repair Equipment for Engine Houses" the statement of the committee in condemning the practice of using old, worn out and obsolete machine tools equipment at this point was strongly commended. It is hard to understand how a tool can be satisfactory for roundhouse use where the work must usually be done more quickly and under more difficult circumstances, which has been discarded as practically useless in the repair shop. This seems, however, to be a fairly general custom. If a tool is too small and light for doing the work at the main shop, where it can be kept in the best state of repair, the line of reasoning which proves it satisfactory for work on the same locomotives under roundhouse conditions was not explained by any of the advocates of this practice. The practice is common, but no members in discussing the report attempted to defend it.

Roundhouse conditions do not require the use of elaborate and complicated machines arranged for high production, but they do demand certain well built simple tools in perfect adjustment. Tools of this character are not so expensive, but what their purchase can be easily justified, when the cost of engine failures or delays at terminals is considered.

In this report the committee made a plea for the use of the term "enginehouse" instead of "roundhouse." It is very doubtful if this will be generally accepted. While in the beginning the term "roundhouse" was descriptive of the structure, its usage has been so common that it has come to be the general term for locations where a turntable is installed with an accompanying housing structure. The English language contains

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many words of this kind which through a period of evolution have lost their exact original meaning, but which are accepted and thoroughly understood, becoming an integral part of the language. The advisability of changing a term which is perfectly understood, and is not at all confusing, simply because it is not now exactly descriptive, will probably not meet with general support. The term enginehouse has been used very generally in the columns of this journal during the past few years largely for the reasons advanced by the committee, but criticisms and arguments from our readers have convinced us that it is impossible and inadvisable to attempt to force it into general use, and the term "roundhouse" is now being employed exclusively as descriptive of a building wherein locomotives are stored, cleaned and repaired if it is served and accompanied by a turntable.

A question which has been uppermost in the minds of many superintendents of motive power in considering the application of superheaters has been the matter of lubrication, and in the beginning it was feared that this feature would prove a stumbling block for high temperature steam. Those applying superheaters at the start adopted forced feed lubricators and other methods to insure a proper supply of oil. The report of the committee this year on the subject of lubrication, however, condemns the forced feed lubricators and states that the common hydro-static lubricator will answer all purposes if the connections and the source of discharge are properly located. After reading the committee's report members who were present at the previous convention and visited the three-cylinder Atlantic type locomotive on exhibition at the Reading station, which uses superheated steam and is equipped with force feed lubricators, and has during the past year been most successfully operating at some of the highest speeds ever obtained in regular service, could not help but be impressed with the ten-wheel locomotive of similar design on exhibition this year, which was also equipped with force feed lubricators, indicating that in one case, at least, this method of lubrication had been satisfactory on very high speed runs with superheated steam.

Experience with injecting graphite mixed with oil in the valves and cylinders was reported as being very favorable, and it is probable that another year will develop many interesting features with this practice.

Members at this convention were greatly handicapped by the late date at which the reports were received, making it practically impossible for them to give any study or thought to the committee's work in most cases. This difficulty has existed in some degree every year, but was worse this year than previously. In the general discussion of the subject on the floor it developed that the fault for this could not be localized, that many things entered into it, and that the members in general were in a large measure to blame for the trouble. It is to be hoped that the experience this year will remain in the minds of members and that they will realize the importance of replying to committees circular letters promptly and fully and that the committees will meet early and frequently until their work is completed, so that the reports can be in the hands of the secretary complete by April 1st, as they should be.

A noticeable feature throughout the sessions was that there was more commingling in the discussions than has generally been observed heretofore. Passing in review the former years of these gatherings, it is well remembered that the various papers presented were discussed by possibly four or five members who had been identified with the positions of speakers since practically the incipiency of the organization, but on this occasion the younger element in railroading were not only called upon by the presidents, but volunteered the recital of their experience for the general good. This is exactly what it should be, as reliance must be placed to some extent at least upon the younger members of the mechanical profession for progressive ideas. This is not said in detriment of those who have taken the most active parts in these proceedings for so many years, and to whose good work these conventions undoubtedly owe their success, but simply to remind that without the injection of new ideas all such deliberations must become lifeless. This convention was noticeable for the fact that men were heard from on the floor who had never previously spoken before this body, and it is equally significant that the remarks essayed by these newcomers were conducive of more enlightenment on the various subjects and inspired a more general discussion.

RAILROAD INSPECTION IN OUTSIDE SHOPS

It is pleasing to note that the present selection of men for the position of inspector in car, locomotive and other shops where railroad work is under contract, appears to be dictated by considerably better judgment than prevailed in former years, and in nine cases out of ten the right man is now in the place. The latter has gradually become endowed with the importance which has long been denied to it, and in the improved order of things the results must be equally pleasing to both the builders and the railroads.

The farcical inspections of only a few years ago well illustrate that the matter is one which has worked out its own salvation, largely from the abuses into which it had fallen. A good machinist of those days was supposedly qualified to inspect the construction of say one hundred locomotives. It may be that he was a man who had never been in a shop other than his own, and had never spoken to a person higher in authority than his foreman or master mechanic, and this with the fact that his authority was ill defined, or not defined at all in many cases, made him of little consequence. Sometimes a draftsman would be selected as inspector, through presumed familiarity with the design of the cars or locomotives under contract, but very often with no shop experience whatever. Various unpleasant situations and complications were inevitable in such instances. It would frequently become necessary for the builders to appeal to the railroad companies, and the latter would reverse the inspector's decision, which implied, of course, his loss of prestige around those particular works for the future. No locomotive or car building concern in the country would ask an inspector's recall until the limit had been reached, and it is really astonishing the patience they have as a whole displayed in contending with incompetent and overbearing men, lightly clothed with brief authority.

Through the system of reform which has been worked, and in which no doubt the Pennsylvania and the Baltimore and Ohio railroads were the pioneers, a very superior class of men are selected to represent the railroads. They are shop men, essentially, but many have sufficient training to conduct the ordinary physical tests of material, are thoroughly familiar with drawings, and possess another sterling qualification in knowing how to properly approach those in authority. From the old plan of a day's pay while on duty at the builder's works they now receive good monthly salaries and expenses, and many of them are ranked with the grade of a general foreman.

Railroad inspection can be conducted pleasantly and profitably for all concerned when the proper man is secured and invested with the necessary authority. The lack of this latter, unfortunately, appears to be the still weak feature of the work. There is no reason for the stream of letters continually flowing between the builder's works and the superintendent of motive power's office, and it would never have started had the position and authority of the inspector been properly defined at the start. While it may be difficult, of course, to secure a properly qualified man in whom this implicit confidence can be reposed, it should not, nevertheless, be beyond the resources of a great railroad. The builders, contrary to a widely extended belief, welcome the presence of a competent inspector in connection with any contract, as he can settle many disputed points which may arise in connection with the interpretation of drawings, or manner in which work should be done. If he meets them half way he will always be so met in return.

Railroads in general are developing this branch of the motive power department, and they are to be congratulated on the great improvement which has been wrought.

Master Mechanics Association—Forty-Fourth Annual Convention

ABSTRACTS OF THE REPORTS OF THE COMMITTEES AND THE DISCUSSION THEREON PRESENTED AT THE CONVENTION HELD AT ATLANTIC CITY, N. J., JUNE 14-16.

The forty-fourth annual convention of the American Railway Master Mechanics' Association was opened on the Million Dollar Pier, Atlantic City, on June 14 with President Fuller (U. P.) in the chair. After prayer by Rev. Caldwell the Association was welcomed by Mayor Stoy in his characteristic style. Mr. Bentley (C. & N. W.) responded to the Mayor, after which the president presented his address, saying in part:

The year 1910-1911 has been a memorable one in so far as it relates to government legislation affecting the railways in general, and the mechanical department in particular. During this period federal laws have been enacted regulating safety appliances for railway equipment; also laws regulating the inspection and care of locomotive boilers. In some states there has been additional legislation, the full crew and caboose bills and headlight bills, while in addition to the federal legislation there has been in some parts of the east, state legislation with regard to boiler inspection. In view of the federal and state legislation on the same matters, it would seem every possible effort should be made to have the state laws either withdrawn or amended to agree with the government legislation.

In the matter of safety appliances your committee, in conjunction with the Master Car Builders' Association, has had this work in hand and has given a great deal of time to it, conferring with the government officials as well as representatives of the railway employees, and a set of rules was formulated covering the requirements.

In my opinion this association should insist on the Interstate Commerce Commission furnishing necessary drawings specifying in detail the location for safety appliances.

Your committee also gave considerable time and work to the boiler bill, and in conference with the government officials arrived at rules governing the matter.

As the work of your special committee on the Safety Appliance and Boiler bills has now been completed and as both of these have to do exclusively with technical matters which can properly be handled by mechanical men, it would seem the future work in connection with these matters should be taken over by the association, and I would recommend the appointment of a committee to handle it. In this connection I cannot too strongly recommend that the members of this association conform promptly to the requirements of the Safety Appliance and Boiler bills, which will indicate to the commission that the railways of America are ready to comply with the law if the requirements are clearly known.

It also appears to me that the requirements of the Safety Appliance act as well as the Boiler bill should be embodied in and adopted as the standards of this association.

In view of past legislation on matters pertaining particularly to the mechanical department, it would seem to me that the policy and work of this association should be more clearly outlined than ever before.

Our experience emphasizes the necessity for looking forward and taking such steps toward uniformity as will enable this association to take the initiative in these matters. I believe this is an opportune time for members of the association to get away from a great many of their personal opinions and get together and agree on the best standards and practices to a greater extent than ever before, and having arrived at such standards they should be followed. Uniformity and unity should be the keynote of our future endeavors.

I see no reason why this association should not have as a part of its recommended practices, mechanical plans for large and small terminals, units embodying the best practices, so that if conditions are such that these plans in their entirety are not feasible or practicable it will be possible to take therefrom the best available features under which shop lay-outs can be designed. There are a good many of the railways that do not employ large and expensive engineering forces and such plans would be of infinite value to such members.

A very pertinent subject in connection with the matter of increased efficiency, to my mind, is the education of our apprentices, in fact of all our employees. By what better method can we hope to increase our efficiency than by setting a high standard for the young men we are educating, from whom we must be able to draw our foremen and shop managers? Progress has been made by some of the individual lines not only in the ways of educating apprentices, but also giving other employees similar advantages by instituting plans of broad scope with educational bureaus open to all employees. It is my opinion that in line with these efforts our association should adopt a recommended apprentice system for apprentices to the various trades as well as for the technical graduates, commonly called "special apprentices."

On the recommendation of my predecessor a committee was appointed in connection with the establishment of a permanent technical bureau within our association. Such a bureau cannot help but be a valuable asset of this association and I cannot too strongly endorse the wisdom of this plan, which I hope will be carried out at an early day. I have indicated the work which has been accomplished by the special committee which conferred with the government officials in the matter of safety appliances and the boiler bill. This simply illustrates what can be done and the value of a centralized bureau to handle subjects which are of a mechanical nature is, it would seem to me, very apparent.

By invitation this association had a representative in attendance at the annual meeting of the Conservation Congress. The aim and work of this congress are something in which every member of this association is vitally interested, and I believe it should have our co-operation and support in every way possible.

The question of consolidating this association with our sister association, the Master Car Builders', has been discussed for some years, and there has been considerable agitation of the matter for the last three years. Committees have been appointed, but up to the present time the proposition has not been settled. It has been the opinion of a great many of the members that the consolidation of the two associations was not feasible and practicable and I leaned to this opinion, but the more I have studied the subject the more I have become impressed with the idea that the union of these two associations will enable us to carry on the work in a far more satisfactory manner. Those of us who have worked in both associations realize what an extra amount of work and time two associations mean for the individual members, and I personally feel the time is ripe for this consolidation or union of the two associations, and I believe the committee should be so instructed to perfect plans so that this consolidation can be accomplished as quickly as possible.

There are a number of important matters confronting railways at this time which should receive our earnest attention and co-operation. We have under consideration and have had committees appointed to investigate during the past year some fifteen subjects comprising important mechanical problems of to-day, and I trust that the reports of the committees will be carefully analyzed and freely discussed to obtain the full benefit of the able work which has been done.

I would call particular attention to the report of the commit-

tee on Design and Construction of Locomotive Boilers. In my opinion this association should arrive at such standards for boiler design as will be adopted and followed by all members.

ASSOCIATION BUSINESS

Secretary Taylor presented his report, which showed that the active membership in June, 1910, was 952; since that time there were transferred to honorary membership, 6; deaths, 11; resignations, 13; dropped for non-payment of dues and mail returned, 1; being 31 deductions from the list as it appeared in June, 1910. During the year there were 78 new members elected and one member reinstated, making the total membership at the present time 1,000. The associate membership is 20, the same as in 1910. The honorary membership is 43, being an increase of 6 since 1910. The total membership is now 1,063. The following deaths have been recorded: Active members: D. F. Van Ripper, H. H. Johnson, J. B. Gannon, A. J. Dunn, David Brown, Wm. Buchanan, H. S. Bryan, G. J. DeVibiss, P. G. Thomas, J. P. Picciolo and S. K. Hatah. The secretary presented the treasurer's report, which showed an income of $6,036.90, and expenses of $5,940.77, leaving a balance of $96.13.

Prof. Louis E. Endsley, Purdue University, and E. A. Averill, managing editor of this journal, were elected associate members of the association.

The association has four scholarships at the Stevens Institute of Technology. There are no vacancies at the present time and there will not be any until September, 1912. The scholarship at Purdue University given by Joseph T. Ryerson & Son, for which they appropriate five or six hundred dollars a year, takes care of the school expenses as well as boarding the student. The present student graduates this spring, and the Ryerson people are willing to extend this another four years if the association desires to co-operate with them. The executive committee accepted this offer.

ELECTION OF OFFICERS

The following officers were elected for next year:

President, H. T. Bentley, Chicago & Northwestern.

First vice-president, D. F. Crawford, Pennsylvania Lines.

Second vice-president, T. Rumney, Erie.

Third vice-president, D. R. MacBain, Lake Shore & Michigan Southern.

Treasurer, Dr. Angus Sinclair.

Executive Committee members, C. A. Seley (C. R. I. & P.), E. W. Pratt (C. & N. W.) and J. F. Walsh (C. & O.).

MECHANICAL STOKERS

Committee:—T. Rumney, Chairman, E. D. Nelson, C. E. Gosset, J. A. Carney, T. O. Sechrist.

The committee feels justified in expressing the opinion that such progress has been made in the development of mechanical stokers as to warrant railroads installing a limited number upon large locomotives at least, and thus lend their aid in the perfection of a device which the committee has concluded is a necessary appliance to heavy tractive-power locomotives, when such locomotives are called upon to exert their full capacity for a prolonged period.

The large locomotives at present being constructed would unquestionably render service nearer their maximum capacity if the firing were mechanical, and the committee is of the opinion that it behooves the members of this association to participate actively by utilizing such stokers as have been developed, and, by actual application, assist in the solving of the many problems which must naturally present themselves during practical operation.

The requirements for mechanical stokers, as recommended by the committee, in brief, are:

That they should be capable of firing coal in excess of the maximum requirements of the locomotive;

That the fire-box door be free of any attachment which would prevent the fireman from giving such attention as fires may require;

Be entirely mechanical from tender to grate;

Be capable of handling bituminous run-of-mine coal, which will include a coal crusher, mechanically operated, on the tender;

Distribute the coal in the fire-box in such a manner as to call for no assistance from the fireman other than regulation of supply and possibly the adjustment of the mechanical appliances for distribution;

Maintain an ideal fire for economic coal consumption without emission of black smoke in objectionable quantities;

Reliability of service.

Previous reports of the committee have directed attention to various mechanical stokers under development, and a summary upon each is presented, with such remarks as are believed pertinent to the subject.

CRAWFORD UNDERFEED STOKER.

This stoker is in service on the Pennsylvania Railroad; its operation has been satisfactory; it is completely mechanical and aims to cover every requirement set forth.*

BARNUM UNDERFEED STOKER.

This machine is in the process of development and so far has been used as a distributor only, requiring coal to be shoveled into the hopper.

The reports from the Chicago, Burlington & Quincy Railroad indicate that the mechanism operated satisfactorily burning an inferior grade of fuel, showing economic results. It is in successful operation on a six-wheel switch engine and a Prairie type freight engine.

A method of crushing coal on the tank and delivering it to the hopper on the engine is now being developed which will make the device meet all the requirements enumerated.

STROUSE OVERFEED STOKER.†

The committee is not able to report fully thereon.

The manufacturers have increased the scope of the apparatus, which formerly consisted of a distributor only, by adding a conveyor from tender.

Satisfactory service has been obtained with regular crews, but the development to date does not permit of complete report.

STREET OVERFEED STOKER.‡

There are ten machines in service, including four on the Lake Shore & Michigan Southern Railroad, one on the New York Central Railroad and the remainder distributed on five other railroads.

The stoker is designed to meet every requirement suggested by the committee, and is successful in its operation.

HANNA OVERFEED STOKER.§

The stoker has been developed only as a distributor.

Consequently, it falls short of the requirements set forth, inasmuch as run-of-mine coal cannot be handled, and shoveling from tender to a hopper is necessary.

The device distributes coal into the fire-box very satisfactorily and is rendering good service on the Queen & Crescent Railroad, operating on Mallet, Consolidation and Pacific type locomotives.

HAYDEN STOKER.¶

The original design failed in two particulars, unreliability and poor design of conveying mechanism and the burning out of coal-distributing plate.

The modified distributor developed independently from the conveyor avoids the distributing coal plate in the fire-box and is giving satisfactory service on the Erie Railroad.

DICKINSON OVERFEED STOKER.

This is a further development of the principle involved in the Hayden stoker and seeks to fulfil the requirements of the committee.

It is in operation on the Erie Railroad and giving satisfactory results in regular freight train service.

BREWSTER UNDERFEED STOKER.

One of the above was recently applied to a locomotive on the Erie Railroad, but owing to modification being required the time was too limited to permit of the results being included in this report.

The stoker is designed to meet all requirements previously mentioned.

It consists in part of a screw placed in the bottom of the tender and covered with movable steel plates, so arranged that a gradual flow of coal is admitted to the screw. The coal is conveyed by means of this screw through flexible coupling to a point below the grates. It is then carried upward through the grates by means of a second screw to the steam jets which are on a level with the bottom of the fire-box door. The blasts from the jets, which work intermittently, are adjustable to meet any condition of fuel or size of fire-box.

The grates are divided into four divisions, two on each side, and by means of a cam—one section at a time—they are tilted slightly forward to advance the fire and agitate the grates sufficiently to keep clear of ashes.

The whole arrangement is operated by a small double-cylinder engine, located on the left side of the locomotive, below the cab.

SUMMARY REMARKS.

This report does not include any tests comparing efficiency

* See AMERICAN ENGINEER, May, 1911, page 161.
† See AMERICAN ENGINEER, April, 1908, page 151.
‡ See AMERICAN ENGINEER, June, 1911, page 232.
§ See AMERICAN ENGINEER, April, 1911, page 121.
¶ See AMERICAN ENGINEER, April, 1908, page 147.

of mechanical stokers to hand firing, as the committee believes that mechanical stokers must be made flexible and reliable machines before any prospects of improved economy in fuel consumption may be expected.

Tests comparing inferior fuel used with mechanical stokers to regular supply for hand firing, thus taking advantage of difference in present fuel values, should not be accepted as proof of economy, as such relations would not maintain with the extension to any appreciable number of mechanical stokers.

The progress during the past year has been sufficiently marked to lead the committee to believe that it can present a final report at the next convention upon at least several of the stokers which have already been developed sufficiently to perform actual continuous service.

Discussion.—This subject brought forth one of the most general and active discussions of any during the convention. Most of the speakers reported on what the stokers were doing in connection with keeping up steam, and practically nothing was mentioned concerning the principles of construction, features of design or methods of caring for them at terminals. The evidence was overwhelming that all of the three principal designs of stokers will fire a locomotive with reasonable reliability.

In reference to a qestion C. B. Young (C. B. & Q.) stated that the Barnum stoker was being tried experimentally with some degree of success. It worked well on a switch engine, but some difficulty had been encountered on road engines.

George A. Hancock (S. L. & S. F.) reported successful service with a large Mallet locomotive fitted with a Street stoker.

T. O. Sechrist (Q. & C.) reported eight engines fitted with Hanna stokers, one, a Mallet, having been in service with a stoker for fourteen months, during which time there had been but two failures, both due to the carelessness of the crew. All eight stokers on different types of freight and passenger service were operating most successfully, handling from 5,000 to 6,000 pounds of coal per hour.

George L. Fowler gave a report of a recent most remarkable trip he had made on a consolidation locomotive fitted with a Hanna stoker. On this occasion the fireman was an inexperienced man, not only with the stoker, but also on a locomotive, but the trip was a record breaker and at no time was there the slightest difficulty with steam pressure or with the operation of the stoker.

In respect to the present status of the stoker, Mr. Fowler, who has made a study of the operation of the three most prominent designs, said:

"In adopting the use of the stoker the men should be given some idea of what they are going to use, what the stoker is for, how it works, and then have the roundhouse forces take care of the stokers. Give the stoker the proper kind of coal, and if you do that, with any of the three stokers now on the market, there is no reason why an engine should not be fired perfectly. I think that the firing can be done more economically with the stoker than it can be done by hand firing."

C. E. Chambers (C. R. R. of N. J.) stated that on a trip with the Crawford stoker he had found the work of the machine to be absolutely perfect so far as steam pressure, absence of smoke, and convenience were concerned.

In speaking of the design of stoker credited to him, D. F. Crawford (Penn.) said in part:

"We have made all told 2,000 trips with the stoker. Of these about 1,600, representing very roughly 160,000 miles, have been made with what might be called the improved stoker. There are at present about 20 locomotives equipped. There are 19 in regular service and we have 10 or 12 more under way. The stokers have all been applied, with the exception of three, to H-6 consolidation locomotives. Two of the stokers are placed on a larger consolidation locomotive and one on a switch locomotive.

"The stokers up to three or four months ago were in the hands of regular crews; in some cases a man rode with them. He was called a stoker instructor, and was simply a fireman who had been taught what the different parts consisted of and what was expected to be done with them. It was his duty to teach the other firemen how to handle the stoker. About three or four months ago five or six of the locomotives were assigned to one division and were turned over to the pool. Out of 1,500 or 1,600 trips that the latest stokers have made, about 800 of them have been 100 per cent. stoker fired; that is, no coal was put in by the shovel at all. One thousand trips have been about 90 per cent. stoker fired or over, and the average of all trips is somewhere about 90 per cent.

"The stoker has been on the testing plant at Altoona. We have made a number of tests with the Salinville coal, which we use regularly, and we have succeeded in firing 6,300 pounds of coal per hour. We have fired that successfully and maintained the steam pressure with it; the performance was in every way satisfactory. I agree fully with the conclusions of the committee as to the desirable points of the stoker. I disagree with Mr. Sechrist, who said that the conveyor should not be used. The stoker is not complete unless it does the whole job. The first stokers that we had were without the conveyor, and they did not appeal to me as meeting the situation.

"Something has been said about coal economy. From the results obtained on our testing plant I think we will do as well, or even better, than the best hand firing. On some of the tests that we have made the stoker has shown conclusively that it will save coal as compared with the average hand firing. However, I do not look to coal saving in itself as being the important point of the stoker. To me the important point is to be able to rate your locomotive not on the size of the cylinders, but on the pounds of coal that it burns. Our consolidation locomotives are probably using from 3,000 to 4,000 lbs. of coal per hour in regular service over a continued run. We want to rate those engines at 5,000 lbs. of coal per hour, and make the train behind the engine a 5,000 lbs. of coal per hour train and do what such a train ought to do. We do not have to build any heavier or bigger engines. All we have to do is to burn more coal and use the engine that we have up to its adhesive ratio."

C. F. Street reported that there were now ten of his stokers in service. He said that in several cases the application of the stoker had increased the capacity decidedly, in one case from 15 to 20 per cent., and that it was this feature that should be the main argument for the use of stokers. Another feature is the increased speed. Stoker engines work on grades where hand fired engines will not. He spoke strongly in regard to the instruction of the firemen in the use of the stoker and to the proper arrangements for taking care of them in the roundhouse. In his opinion a stoker to be successful must be able to handle any quality of fuel furnished it.

M. H. Haig (Santa Fe) expressed himself as surprised at the uniformity of the favorable reports inasmuch as his experience with three designs of stokers, the Street, Hanna and Strouse, were quite different. They all were extravagant on fuel and had difficulty maintaining steam pressure.

J. F. Devoy (C. M. & St. P.) said that after a year's experience he could say nothing complimentary for the Strouse stoker. He agreed with the committee that a conveyer should be provided.

G. A. Hancock said that they had considerable trouble with a Street stoker at the beginning, but after the firemen became accustomed to it the trouble disappeared.

T. Rumney (Erie) advocated the conveyor as a necessity, stating that he had worked four years to get a satisfactory design.

SAFETY APPLIANCES

Committee:—Theo. H. Curtis, M. K. Barnum and C. B. Young.

[The report was confined largely to quoting the orders of the Interstate Commerce Commission dated March 13, 1911, regarding sill steps, handholds, uncoupling levers, couplers, end ladders, running boards, etc., for locomotives in the different classes of service, viz., switching or road. Copies of the original order can be obtained upon request to the Interstate Commerce Commission.—ED.]

Theo. H. Curtis (L. & N.), chairman of the committee, supplemented the report as follows:

Referring to the Interstate Commerce Commission standards for steam locomotives in road service and the location of the sill steps, there have been a great many questions asked as to where the roads are going to place this sill step. The order is very plain that it must be outside of the rail, and not over 16 in. above it. It may be placed on the face of the bumper beam, or it may be placed on the rear of the bumper beam, or it may be placed on the pilot; so long as it is outside of the rail and not over 16 in. above the rail, it complies with the law. There are some railways that use this step entirely, where the clearance will permit it, on the rear of the bumper beam. Other railways use it and have the same attached to the pilot. Some are applying it on the face of the bumper beam. I wish to

call your attention to the fact that this sill-step is to have a metal tread 8 in. by 10 in. It says it also may have a wooden tread. My interpretation of this is that sill step must have a metal tread. If you wish to put a wooden tread on top of it you can.

The pilot beam handholds and rear-end handholds for steam locomotives in road service are to be ⅝ in. in diameter with a minimum clear length of 14 in., preferably 16 in., and minimum clearance of 2½ in. The end handhold for steam locomotives used in switching service must be 1 in. in diameter, with 4 in. clearance, except at coupler casting or braces, when minimum clearances shall be 2 in. Under the location we learn that this handhold shall extend across the front end of the locomotive, in the rear of the tender. You will note that the road engine has a different handhold from the switch engine. There is nothing said in the order as to when the road engine becomes a switch engine, but it is reasonable to understand that a road engine could not switch too long and not become a switch engine; therefore it becomes almost necessary to equip your road engine as a switch engine in order that you may transfer a road engine to switch engine service. The handholds on a switch engine would be permissible on a road engine, but the handholds on a road engine would not be permissible on a switch engine.

The important feature of the end clearance is the 14 in from the vertical plane passing through the inside face of knuckle when closed with the horn of coupler against buffer block or end sill. There are exemptions made for air hose, steam hose and different appliances, but there are no exemptions made for bolt heads, rivets or push pole pockets Therefore the matter stands about like this: There are 14 in. required by law; about half an inch will have to be added for contingencies, 3 in. will need to be added for push pole pockets and other parts of the tender that are not exempt, and 2 to 3 in. clearance must be added for compression of the spring, making a total distance of about 20½ in. from the end sill to the inside of the knuckle. Now, this is a very long overhang to maintain on a switch engine. Especially is this so when it is required on a switch engine, and a road engine may be made a switch engine almost momentarily. So it becomes practically necessary to equip a road engine with a very long distance between the knuckle and the end sill. With this long overhang, or distance, we begin to have some more trouble. The uncoupling lever arm will be very long, it may be 15 to 18 in. long. In fact, it is so long that it is very hard to lift the knuckle. This uncoupling apparatus must extend near the full width of the tender; there is very little allowance left. There is nothing said in the law as to the length of the arm on the outer end of the uncoupling lever as it applies to locomotives, but there is as applied to cars. It is open to reasonable interpretation that this lever must not be too long. If it is too long, when the trainman on one side of the tender or pilot raises the uncoupling lever the long handle will stick out on the other side and perhaps injure a fellow-trainman.

These difficulties must needs be obviated after a very careful study of this safety appliance question and after, I might say, a conference of your best men in an endeavor to ascertain how it can be applied to your locomotives. I have held several of these conferences with the officials of the road with which I am connected, and we feel that we have learned a great deal about the application of safety appliances, but we believe there is still much more to learn.

Discussion.—The president drew attention to the requirement for increased length of drawbar head on tenders, and it was explained by Mr. Wilden that the committee of the M. C. B. Association would make a report covering this.

C. A. Seley (C. R. I. & P.) spoke on the requirements covering engines used in switching service, which seemed to practically include all freight locomotives as well as switching locomotives. He recommended that all road engines be fitted up under the switch engine requirements so far as handholds and clearances are concerned. The tapered front buffer beam proved to be of considerable advantage in obtaining the required clearance where a man stands.

J. H. Manning (D. & H.) recommended that no new coupler head be adopted, but that the yoke be lengthened and filling blocks be inserted to give the required clearance.

Mr. Curtis stated that he had attempted without success to use the standard coupler head with an increased length of yoke. He believed a new head measuring 13½ in. from horn to face of knuckle was the solution.

LOCOMOTIVE PERFORMANCE UNDER DIFFERENT DEGREES OF SUPERHEATED STEAM

By C. H. Benjamin and Louis E. Endsley.

The work done by Dean W. F. M. Goss, reported by him to this Association in 1909, and the further work done by the authors of this paper, reported to the Association in 1910, seemed to show a progressive improvement in the efficiency of the locomotive with an increase of superheat. It was also apparent that the improvement in the efficiency had not reached a maximum, but continued to grow as the temperature of superheat increased. For this reason, it seemed desirable to attempt still higher temperatures, and to determine, if possible, any maximum point in the curve of efficiency. The locomotive Schenectady No. 3 has accordingly been equipped with a Schmidt superheater, giving substantially more superheating surface than the ones formerly used, as may be seen by reference to figures in this report. This has rendered possible the use of still higher temperatures, so that, whereas in previous experiments a maximum of about 200 degrees of superheat was obtained, from 200 to 275 degrees were used in the experiments described in this report.

Two conditions were to have been expected in these experiments: first, practical difficulty with the lubrication of the slide valve; second, less rapid improvement in economy at the higher temperatures. Neither of these conditions has been realized. Practically no difficulty was experienced with the lubrication of the valve, and no maximum of economy has been reached. As far as the figures and tables in the present report are evidence, the coal consumption decreases more and more rapidly as the superheat becomes higher. There seems to be no practical limit to the gain to be obtained in this way, except the usual troubles incident to the use of superheated steam.

The present report is shaped largely on the lines of that made by the authors last year in order to facilitate comparison. Although these experiments are not yet completed, it has seemed advisable to call to the attention of the Association the results so far obtained.

Equipment.—The same locomotive, now known as Schenectady No. 3, was used in all the tests. When used with saturated steam the locomotive was in normal condition. After the tests on saturated steam had been completed it was first equipped with a Cole superheater, and the results from tests of superheated steam, as reported to the Master Mechanics' convention in 1909, were obtained with the original superheating surface of 193 square feet (neglecting header). The work as reported last year was from results obtained after reducing the superheating surface by two successive decrements of 42 square feet each, or approximately 21 per cent. at each reduction.

Prior to the experiments described in this report, the locomotive had been overhauled and a Schmidt superheater installed in place of the Cole superheater, in order to distinguish between the different superheaters as used on Schenectady No. 3, in last year's report, the first superheater was known as "Cole A," the second as "Cole B," and the third as "Cole C." The superheater in this year's report is referred to as the Schmidt. The heating surface of the tubes of the four superheaters are:

Cole A, 193 square feet; Cole B, 151 square feet; Cole C, 109 square feet; Schmidt, 324 square feet.

The boiler dimensions were the same for all the Cole superheater tests, but in order to install a Schmidt superheater, with a larger amount of superheating surface, the number of small 2-inch flues was reduced from 111 to 107, and the large 5-inch flues were increased in number from 16 to 21. This change in the number of flues increased the water-heating surface from 897 square feet to 956.5 square feet. With the above exceptions, the boiler and engine were the same for all the testing upon the four different superheaters.

The nominal dimensions of Schenectady No. 3, as used in the tests with the Schmidt superheater, are as follows:

Type	4-4-0
Total weight about	109,000 lbs.
Weight on four drivers about	61,000 "
Driving-axle journals:	
Diameter	7½ in.
Length	8½ "
Drivers, diameter	68.99 "
Valves—Type, Richardson balanced:	
Maximum travel	6 "
Outside lap	1⅛ "
Inside lap	0 "
Ports:	
Length	12 "
Width of steam port	1.5 "
Width of exhaust port	3 "
Total wheel base	23 ft.
Rigid wheel base	8.5 "
Cylinders:	
Diameter	16 in.
Stroke	24 in.
Boiler—Style, extended wagon top:	
Diameter of front end	.52 "

Number of 2-inch flues	107 "
Number of 5-inch flues	21 "
Length of flues	11.5 ft.
Heating surface in flues	956.5 sq. ft.
Heating surface in fire box	123.5 " "
Total water-heating surface	1080.0 " "
Length of fire box	72.06 in.
Width of fire box	34.25 "
Depth of fire box	79 "
Grate area	17 sq. ft.
Thickness of crown sheet	7/16 in.
Thickness of tube sheet	9/16 "
Thickness of side and back sheet	3/8 "
Diameter of stay bolts	1 "
Diameter of radial stays	1 1/8 "

The Schmidt superheater, as used in these experiments, has the following dimensions:

Outside diameter superheater tube	1 3/8 in.
Number of double return loops	21
Average length of the pipes in the double return loops	42.8 ft.
Total superheating surface, based on the outside surface of the tubes	324 sq. ft.

The total water and superheating surface of the locomotive equipped with the Schmidt superheater is 1,404 square feet.

Tests with Schmidt Superheater.

Following the method primarily adopted, the tests on the Schmidt superheater were run at 200, 160 and 120 pounds pressure. The tests at 240 pounds were omitted because it was felt that there was no further need of tests at this high steam pressure. The speeds and cut-offs adopted for the tests were the same as those used last year. These tests were all run during the months of April and May of this year.

Lubrication of the Valves and Cylinders.—Because of the fear expressed by several railroad men, that the lubrication of the valves, which are slide valves, would be difficult when using a higher degree of superheat, a transfer filler was added to the lubricator, thus increasing its capacity. After a few tests, however, it was found that no more oil was required with the Schmidt superheater than was used with the Cole superheater.

The oil used in all of the superheater tests was 600 W. The amount of oil used was approximately one drop (through a sight-feed lubricator) to each valve box for each 12 to 30 revolutions of the locomotive, and one drop to each cylinder for each 30 to 60 revolutions of the locomotive, depending upon the length of valve travel. That is, a short cut-off and high steam pressure required more oil than a long cut-off and lower steam pressure. The amount of oil used in a 75-mile run (this being the length of each test) varied from 1½ pints to 3 pints. This amount of oil may seem rather high to a railroad man, but to insure against the cutting of the valve, more oil was used than was really necessary, as was shown by the fact that during none of the tests was there any evidence of dry valves. An inspection of the valves and cylinder wall after all the tests had been completed showed a high polish and no cutting.

Evaporative Efficiency of the Combined Boiler and Superheater.—The first fuel used in all tests was Youghiogheny lump. The equivalent evaporation (pounds of water evaporated from and at 212° F.) per pound of dry coal, plotted against rate of evaporation (equivalent evaporation per foot of water-heating and superheating surface per hour), is given by the equation

$$E = 12.45 - .318\ H$$

where E is the equivalent evaporation per pound of dry coal and H is the equivalent evaporation per square foot of water-heating and superheating surface per hour. The area of the heating surface is based upon the interior surface of the fire box, and the exterior surface of the boiler and superheater tubes. This equation is derived from all tests at all pressures, and, therefore, fairly represents the average performance of the boiler at any pressure. It is to be noted that a majority of the points which represent individual tests fall very near the average line, which was obtained by finding the center of gravity of two groups of points and drawing a line through the two points thus found.

The Degree of Superheating.—The method of measuring the temperature of superheated steam was the same as that employed in the tests of the other superheaters. High-grade mercurial thermometers were placed in thermometer wells in the branch pipe at a point directly adjoining the superheater header. The equations for the lines plotted showing the superheating degrees Fahrenheit plotted against the rate of evaporation are given below in Table I. In order to obtain a common slope for all lines for all pressures, the points were averaged in two groups and the dotted line through these two average points used as the common slope. Other lines were then drawn parallel to this line through the points corresponding to each pressure.

TABLE I.

DEGREES SUPERHEATING UNDER DIFFERENT PRESSURES.

Boiler Pressure.	Equation.
120	$T = 107 + 16.5\ H$
160	$T = 101 + 16.5\ H$
200	$T = 90 + 16.5\ H$

In the above table T equals the superheating degrees F, and H equals the equivalent evaporations per square foot of water and suprheating surface per hour. Assuming a rate of evaporation which will give approximately 440 indicated horse-power, which is 8.5 pounds, the corresponding values of T for the various pressures can be obtained. The value of superheaters is expressed for the Schmidt superheater by the equation

$$T = 133.8 - .216\ P + 16.5\ H$$

where T equals the superheat in degrees Fahrenheit, P equals the boiler pressure in pounds gauge and H equals the equivalent evaporation per square foot of heating surface per hour. The above equation is applicable for any pressure and any rate of evaporation.

The Ratio of Heat Absorbed per Square Foot of Superheating Surface to that Absorbed per Square Foot of Water-heating Surface.—If the efficiency of the superheating surface be expressed as a ratio of heat transmitted through it to the heat transmitted through the water-heating surface of the boiler, or as the ratio of the equivalent evaporation per square foot, and this ratio be plotted for each test against the corresponding equivalent evaporation per square foot of water-heating surface per hour, it is seen that the efficiency of the superheating surface is increased with increase in the rate of evaporation. It is worthy of note that the efficiency of the superheating surface is equal to fifty per cent. of that of the water-heating surface when the equivalent evaporation per square foot of water-heating surface per hour is 13 pounds or more.

STEAM PER INDICATED HORSE-POWER PER HOUR.

SUPERHEATER	BOILER PRESSURE POUNDS BY GAGE	SUPERHEAT DEGREES F.	POUNDS STEAM PER INDICATED HORSE-POWER PER HOUR	B.T.U. PER INDICATED HORSE-POWER PER MINUTE
I	II	III	IV	V
SCHMIDT "A"	240	222.2	19.5	421.4
SCHMIDT "A"	220	226.5	19.0	410.7
SCHMIDT "A"	200	230.8	18.9	408.3
SCHMIDT "A"	180	235.1	18.7	404.0
SCHMIDT "A"	160	239.4	18.9	408.0
SCHMIDT "A"	140	243.8	19.5	419.8
SCHMIDT "A"	120	248.6	21.0	452.3
COLE "A"	240	139.7	22.6	474
COLE "A"	220	145.0	21.8	459
COLE "A"	200	150.3	21.6	455
COLE "A"	180	155.6	21.9	461
COLE "A"	160	160.8	22.3	468
COLE "A"	140	166.1	22.9	481
COLE "A"	120	171.4	23.8	497
COLE "B"	240	120.6	22.6	469
COLE "B"	220	126.8	22.1	460
COLE "B"	200	133.0	21.8	454
COLE "B"	180	139.2	22.1	460
COLE "B"	160	145.4	22.5	469
COLE "B"	140	151.5	23.0	479
COLE "B"	120	157.7	23.8	496
COLE "C"	240	109.9	22.7	469
COLE "C"	220	114.6	22.5	465
COLE "C"	200	119.4	22.6	467
COLE "C"	180	124.2	22.8	472
COLE "C"	160	128.9	23.5	486
COLE "C"	140	133.7	24.0	496
COLE "C"	120	138.4	24.8	512
NONE	240	0	24.7	483
NONE	220	0	25.1	491
NONE	200	0	25.5	498
NONE	180	0	26.0	507
NONE	160	0	26.6	517
NONE	140	0	27.7	537
NONE	120	0	29.1	563

TABLE II.

Smoke-box Temperatures.—The temperature of the gases in the smoke box was obtained by the use of a mercurial thermometer placed midway between the diaphragm and the front tube sheet. The equation of the line drawn through the points plotted between the smoke-box temperature for each test and the rate of evaporation is

$$T = 500 + 13.08\ H$$

where T equals the smoke-box temperature in degrees Fahrenheit, and H equals the rate of evaporation.

A Comparison of Results Obtained with Saturated and with Four Different Degrees of Superheated Steam.

Basis of Comparison.—As was pointed out last year, it seems logical to compare the four different degrees of superheated steam with that of saturated steam, since all the series of tests so far run have been under the same steam pressures and cut-offs, developing approximately the same horse-power, the only difference being the area of the superheating surface and the area of the water-heating surface. As the area of the water-

COAL CONSUMPTION UNDER DIFFERENT PRESSURES AND SUPERHEATERS.

BOILER PRESSURE POUNDS GAGE	POUNDS OF COAL PER INDICATED HORSE POWER PER HOUR				
	SATURATED STEAM	SUPERHEATER COLE "A"	SUPERHEATER COLE "B"	SUPERHEATER COLE "C"	SUPERHEATER SCHMIDT "A"
I	II	III	IV	V	VI
240	3.31	3.12	3.24	3.20	2.63
220	3.37	3.00	3.16	3.16	2.57
200	3.43	2.97	3.11	3.18	2.55
180	3.50	3.01	3.16	3.22	2.51
160	3.59	3.08	3.24	3.35	2.55
140	3.77	3.17	3.33	3.45	2.63
120	4.00	3.31	3.48	3.60	2.82

TABLE III.

heating surface of the boiler with the Schmidt superheater is approximately only 47 square feet greater than with the Cole superheater, it would seem that this difference would not be enough to affect the relative efficiency of the boiler. In the comparisons which follow, therefore, no allowance is made for differences resulting from different water-heating surfaces.

In the tables anad diagrams which follow, all material included under "Saturated Steam" and superheater "Cole A" has been taken directly without change from the 1909 report, and that under superheaters "Cole B" and "Cole C" from the 1910 report.

Comparison of Engine Performance.—The steam consumption of the locomotive operated under saturated steam and the four different degrees of superheated steam represented by "Cole A," "Cole B," "Cole C" and "Schmidt," are shown graphically in Fig. 1. The numerical values are given in Table II. From an inspection of these curves, it is seen that the tests with the Schmidt superheater, that is, the one giving the highest degree of superheat, gave the lowest water consumption.

The curves showing the relation between the B. T. U. per I. H.-P. per minute for the different conditions of tests are given in Fig. 2.

The relation in coal consumption per I. H.-P. per hour for the four different superheaters and for the saturated steam is shown graphically in Fig. 3, the numerical values being given in Table III. Here again the Schmidt superheater results are the smallest, going as low as 2.5 pounds per indicated horse-power per hour.

The consumption of water per indicated horse-power as affected by the degree of superheat, is well shown in Fig. 4, in which the pounds of steam per indicated horse-power per hour are plotted against the degrees of superheat. The pounds of steam per indicated horse-power per hour were obtained from the curves shown in Fig. 1. It will be seen that the comparisons are made at 160, 180 and 200 pounds steam pressure, these being the pressures that fall in the center of the field of experiment, and for that reason would be more likely to represent correct results.

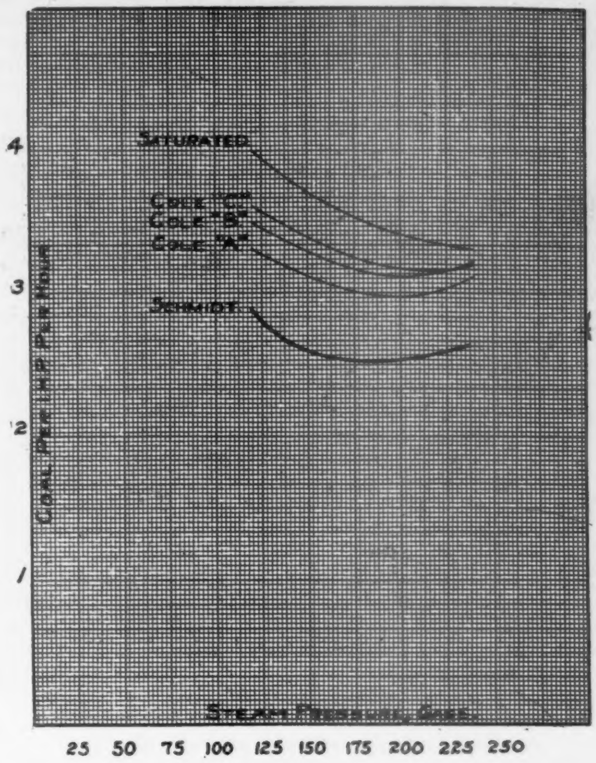


FIG. 1.

As indicated last year, it would seem that this relation could be approximately represented by a straight line as shown. It is also seen that the water consumption for all pressures between 160 and 200 pounds for the Schmidt superheater is practically the same.

Coal Consumption.—The pounds of coal per indicated horsepower per hour plotted against degrees of superheat are shown in Fig. 5. The pounds of coal per indicated horse-power per hour were obtained from the curves of Fig. 3, and the degree of superheat was obtained in the same manner as for Fig. 4.

The same pressures of 160, 180 and 200 were used in this comparison as in the comparison for steam consumption. This

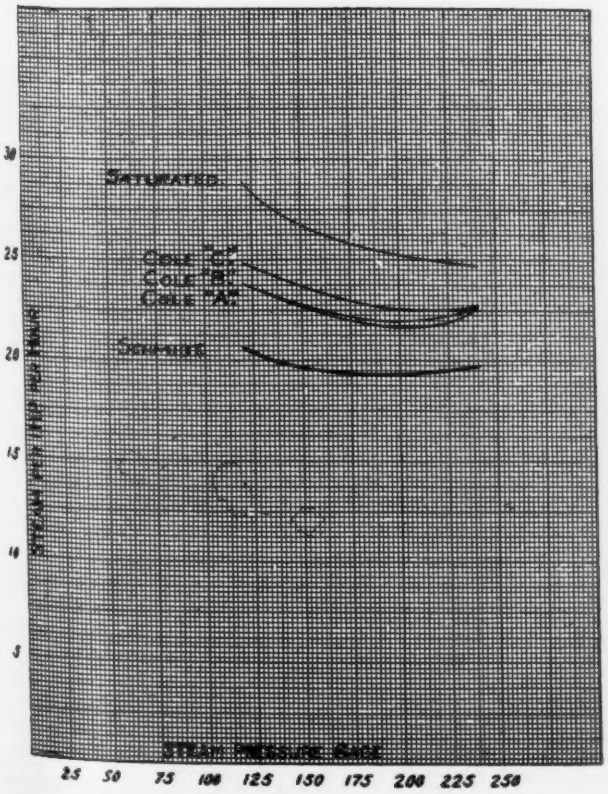


FIG. 3.

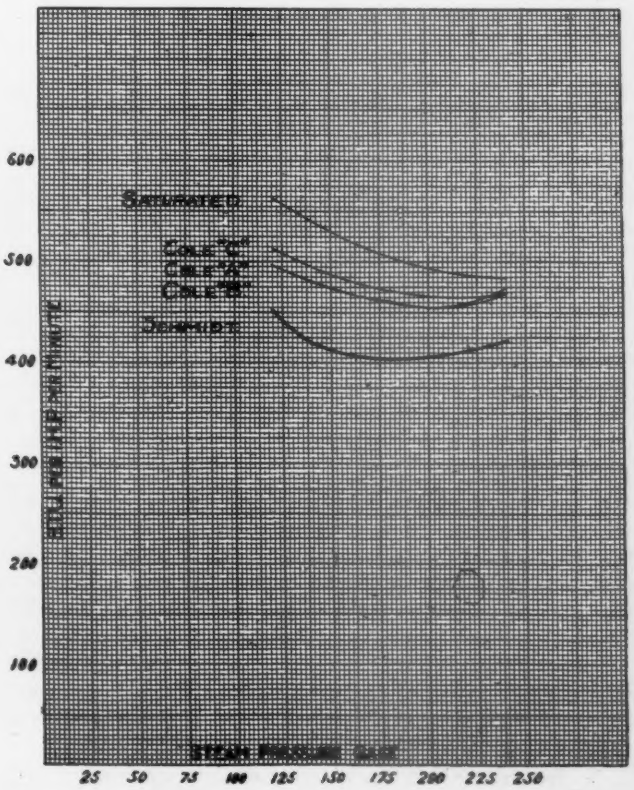


FIG. 2.

relation between the coal per indicated horse-power per hour and the degree of superheat for pressures of 160, 180 and 200 would seem to indicate, as brought out last year, that it could be represented by a curve as shown. In other words, the first 80 or 100 degrees of superheat does not make the same pro-

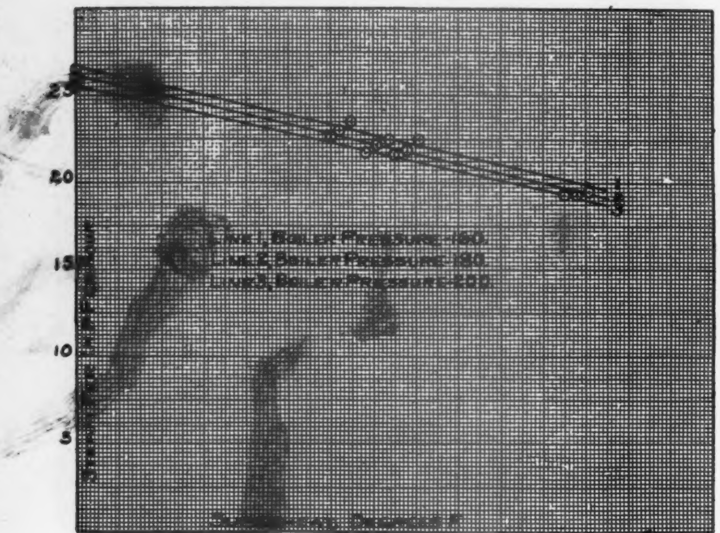


FIG. 4.

portionate decrease in coal consumption as does the second 80 or 100 degrees, and, in like manner, the third 80 degrees increase makes a still greater reduction in the coal consumption. For instance, the coal consumption per indicated horsepower per hour at 180 pounds steam pressure for the locomotive using saturated steam was 3.50 pounds, and for 80 degrees of superheat it was 3.4 pounds, a gain in efficiency of 2.8 per cent.; while the consumption at 160 degrees superheat is 3.05 pounds, a gain of 12.8 per cent., and the coal consumption at 240 degrees superheat is only 2.47 pounds, a saving of 29.4 per cent. over that of the locomotive using saturated steam. Thus, if we take the locomotive using saturated steam as consuming 100 per cent. of coal, it might be said that the first 80 degrees superheat will reduce this 2.8 per cent., the second 80 degrees 10.0 per cent., and the third 80 degrees, 16.6 per cent., making the total reduction for 240 degrees superheat, at 180 pounds pressure, 29.4 per cent. Practically the same results would be obtained for the curves representing 160 and 200 pounds steam pressure.

CONCLUSIONS.

a. A locomotive equipped with a superheater giving from 200 to 240 degrees of superheat will, during the time of running, effect a saving in coal consumption of from twenty to thirty per cent. over that of the same locomotive using saturated steam.

b. It would seem that the total gain in efficiency which could be obtained from superheat in a locomotive would not be reached until the temperature became too high for practical purposes.

Discussion.—Prof. Arthur Wood (Penn. State), on being given the privilege of the floor, raised a question as to the fairness of comparing the first 80 degrees superheat with the second 80 degrees, because of the probable presence of an indeterminate amount of saturated steam in the cylinders. He also asked for information on the probable location of the point of net economy when interest, depreciation, etc., of the apparatus is considered. This point in stationary practice is in the neighborhood of 100 degrees superheat, and for locomotives he thought that it would probably be below 270 degrees.

H. H. Vaughan (C. P. R.) stated that this paper explained clearly the causes of results he had reported at previous conventions, but was unable to explain. This referred particularly to his stand on the comparative uselessness of using low degree superheat. He had always placed the low limit at 160 degrees, but in view of recent results now believed that that figure was too low. He drew particular attention to the curves, showing the increased economy when the locomotive was working the hardest. While savings of 15 to 20 per cent. might be shown for a whole trip, when the locomotive was working hardest the saving or increased capacity was much more than this.

H. T. Bentley (C. & N. W.) reported entire success with superheaters on his road. The results of such tests as had been made checked those given in the paper very closely. The superheater engines were very popular with the crews, dispatchers and operating officials. Some trouble was at first given with lubrication, but the substitution of a single large lubricator on the right side of the cab for the two, one right and one left, had corrected it.

C. D. Young (Penn.) asked for information concerning the probability of getting equal economy with the combination of lower superheat and higher steam pressure, as was indicated by the curves given in the paper.

J. F. DeVoy (C. M. & St. P.) reported comparative tests with a superheater engine which checked the results given in the paper very closely. He was most favorably impressed with the work of the superheater in every way, and believed that a saving of 25 per cent. could be expected as a general proposition by its application.

Professor Endsley in closing the discussion stated that the low boiler pressure tests referred to by Mr. Young took into consideration other factors besides economy. No attempts had been made this year to find out concerning the increased power due to superheat. That feature would be next year's program. In reply to Professor Wood, he said that figures were not obtainable at present to show the point of net economy.

REPAIR EQUIPMENT FOR ENGINE HOUSES

Committee:—C. H. Quereau, Chairman; W. H. Fetner, H. P. Meredith, A. G. Trumbull, J. A. Carney.

We realize that no one solution will fit all conditions and that each engine house should have special study. At the same time, we believe there are a few general principles which should be kept in mind in the design, personnel, equipment and management of all engine houses.

It seems axiomatic that locomotives should be worn out in legitimate service as soon as possible. The capital invested in a locomotive represents a certain total of earning capacity, and the sooner this total earning capacity is realized the greater will be the yearly returns on the capital invested. In other words, a locomotive should be in service, earning as large a percentage of the time, and in the engine house or shop spending as small a percentage of time and money, as possible.

It also seems self-evident that the greater the efficiency of a locomotive, both in hauling capacity and fuel consumption, the greater the earning of the capital invested in it.

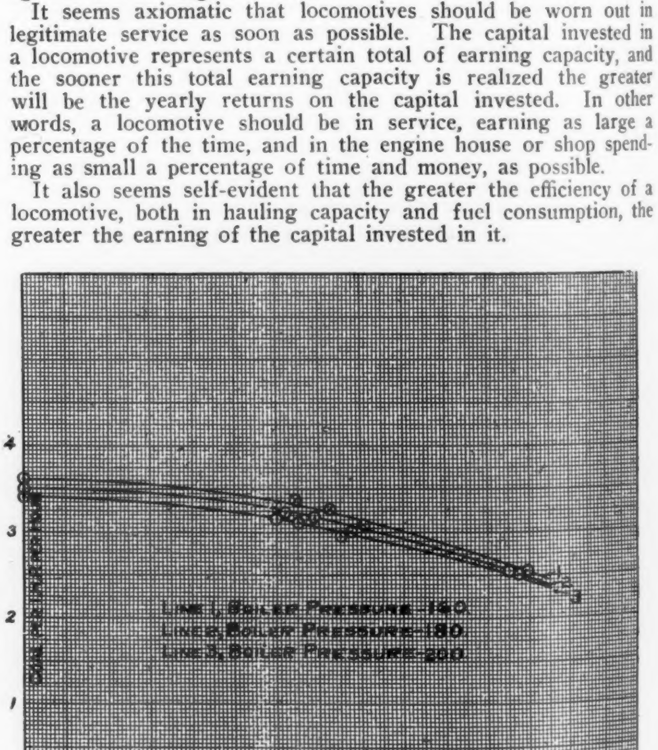


FIG. 5.

If it is a sound business proposition to wear out locomotives in service in as short a time as this can be done legitimately and to keep them as near one hundred per cent. efficiency as possible, these principles should be kept in mind in determining the extent to which repairs should be made at engine-houses, and this policy, once settled, in turn largely determines the repair equipment needed. In this connection we should not overlook the fact that any repairs made at engine-houses, more than light running repairs, increase the main shop capacity to a corresponding extent.

In order to obtain an approximate estimate of the net daily

earnings of a freight locomotive, the following calculations have been made. The gross freight earnings of a trunk line for the year 1910 were divided by 365 to get the average daily gross freight earnings. This result was divided by the total number of freight engines owned, plus nine-tenths of the switch engines owned. It was assumed the operating ratio for freight service was 60 per cent., leaving 40 per cent. net operating income. The result was that $45 was found to be the approximate daily net operating income from each locomotive engaged in freight service. This computation assumes each freight locomotive was in service every day. This means that we could afford to invest $900 capital at 5 per cent. in engine-house repair equipment for each extra day in service we could obtain for each freight engine owned, by making the repairs at the engine-house instead of at the main shop. Expressed more concretely, it means that, if the engine-house repair equipment kept each of 100 freight engines in service two extra days a year, the extra net operating income would be 5 per cent. on a capital of $180,000. This does not necessarily mean an increased net operating income, as it may, and in the end probably would, mean a smaller capital invested in freight locomotives.

While the fixed charges at main repair shops do not appear in reports showing the cost of locomotive repairs, it is evident they enter into costs and should therefore not be ignored. With a view to determining approximately the importance of this item, the figures for a shop at which no car repairs are made, repairing about 600 engines during 1910, have been taken. The average cost of repairs per engine, including labor and material, was found to be about $1,200, so there must have been a considerable proportion of the engines which received only medium and light repairs. This plant, including land, buildings, machinery and tracks, has a book value of about $1,000,000. Assuming that 10 per cent. of this value represents the fixed charges, these amount to $100,000 a year, or slightly less than $170 per year per engine receiving repairs at that point. It is interesting to note that the fixed charges amount to between 15 and 20 per cent. of the total amount charged at this shop to engine repairs for 1910.

The cost of fixed charges for another shop, at which, with the exception of some miscellaneous work, only locomotives are repaired, amount to $234.94 per year for each engine repaired, and are 13.2 per cent. of the total value of the plant.

In all probability it will be conceded it would be a waste of time and money to run a locomotive to the main shop to have a driving-box cellar repacked or the flues cleaned. Why? Because it would involve time lost from revenue service getting the engine to, through and from the shop, reducing the yearly earnings of the engine; necessitate the use of main shop space, increasing the capital invested in shops, or reducing the main shop output; congest the shop-track movements and disarrange the shop routine, thus delaying other more important shop work. At the main shop, though the item does not appear in the statistics showing the cost of repairs, there are the shop fixed charges, including interest on the investment, repairs, taxes and insurance, a no inconsiderable item. At the engine-house the fixed charges would be very much less, as they would not include those of the engine-house proper, the tracks, turntables, ash pits, coal chutes and other facilities necessarily provided, and would cover only the comparatively small investment in the shop building and machinery provided for repair work.

There can be little room for doubt that when there is a great demand for motive power, engine-house foremen and master mechanics, rather than send engines to the main shop, though this is near at hand, will take chances, resulting in breakdowns and delays; which would not be taken if they had repair equipment of their own. In other words, with tools and men under their immediate control and responsible for results, engine-house men will, in all probability, keep the motive power in better condition, more efficient and less liable to breakdown, and take a greater pride in making repairs quickly than when repairs must be made by an independent organization.

It is, we believe, common experience that the qualifications of engine-house employees should be quite different from those of repair-shop men. The work of the repair-shop man is steady and should be accurate, thorough and first-class in every respect, with the aim that a locomotive shall remain out of the repair shop as long as possible, and there is no pressing necessity that his job be finished by a certain minute. In contrast to this, the work of the engine-house man is spasmodic; at certain hours he is extremely busy, working under high pressure, and again has little to do. His chief care is to have the engines ready for their next run and in such condition that they will make at least a round trip successfully. If he accomplishes this, he is not criticised if his work is not exactly to blue-print or standard and rather coarse. His training makes him fertile in make-shifts to "get the engines over the road" without a breakdown or delay, which the shop man would, and should, refuse to countenance.

Probably because of this difference in ideals, viewpoint and methods of the shop man and engine-house man, when an engine goes to the main shop from the engine-house to have a certain part repaired it usually happens that a considerable amount of other work is done which would not have been done at the engine-house and could just as well have waited till a general overhauling was needed. In other words, when repairs, other than general, are made at the main shop, more work is usually done than is necessary. It is very likely the further fact that the shop man's experience is not such as to educate his judgment as to what work he can with safety let go, prompts and impels him to do more than necessary. Whatever the cause, there can be little doubt as to the fact. To those lacking the experience, it no doubt seems that this practice could be stopped by the issue of proper instructions and supervision, but proper instructions do not change human nature or lifelong habits, nor does a reasonable amount of supervision seem to work the miracle.

It is commonly the case at engine-houses that tools are frequently missing or inefficient for lack of repairs, resulting in considerable useless expense not only for tools, but in time lost in hunting them and exasperating delays in making repairs. We believe the remedy for this is a tool room, with some one in charge whose duties should include not only the issuing of tools on checks, but as well keeping the tools in good condition and a proper supply on hand.

If a locomotive must lay in the engine-house a day for lack of the material necessary to repair it, there follows a loss of earning power which, if expressed in dollars, would pay a good interest on a considerable investment in storeroom stock. It requires no labored argument to convince a motive-power official that a storeroom in connection with an engine-house is an essential, but not all of them appreciate its relation to the earning power of the equipment for which they are responsible. It is the opinion of the committee that a reasonable business basis on which to determine the most economical amount of stock to carry at engine-houses, assuming, of course, that stock carried is only that needed for engine-house repairs, is its effect in increasing the earnings of the locomotives.

We believe there should be kept at all important engine-houses an ample supply of spare parts, such as air pumps, lubricators, injectors and bell ringers, which should be used to replace defective apparatus whenever it will take less time to exchange than to repair, and as a general proposition, that important repairs to such accessories can be made to the best advantage at the main shops, where special tools and machinist specialists are available. It seems evident that the interest on the investment in spare parts must be less than the loss in earnings resulting from not having them.

The conditions under which engine-house work is of necessity done are much dirtier and more inconvenient than in the repair shop, and the rates of pay usually not so attractive. It follows that to get and keep a desirable class of men, engine-house conditions should be made as attractive and convenient for them personally as possible, including good ventilation and heat, lockers, toilet and washroom accommodations kept in first-class condition. It seems to us particularly important to have a system of ventilation which will quickly and thoroughly carry off the steam and smoke, which are necessary in an engine-house, that work may be done more rapidly and efficiently than would otherwise be the case.

It is not an unusual policy in equipping important engine-houses to use worn-out and obsolete tools. We believe this is short-sighted, not only because a big shop is better able to find profitable use for such tools and better able to keep them in repair, but engine-house conditions warrant the best of tools. If a tool is not efficient enough for repair-shop work it will generally pay to scrap it.

We should, therefore, when studying the requirements of round-houses, determining the kind of work to prepare for and the repair equipment needed, have in mind the following points:

Locomotives should be held out of service for repairs as short a time as possible.

Should be kept as near 100 per cent. efficiency as possible.

The effect on earnings of time saved by repairs made at engine-houses.

The effect on engine efficiency of repairs made at engine-houses.

The smaller fixed charges for repairs made at the engine-house, compared with those at the main shop.

The effect of storeroom stocks on engine earnings.

Engine-house men should have ideals and methods quite different from those of shop men.

It is important that engine-house conditions and facilities should be attractive and convenient to get and keep good men and increase their efficiency.

These conclusions can be generalized in the statement that locomotive repairs and repair facilities at engine-houses are warranted when they will result in increased earnings either because of more or better engine service obtained from a given number of locomotives.

Appendix.

Engine-houses may conveniently be classified under three heads: Those at minor division terminals, or the outlying ends of branch lines, where only very light repairs are made; those at important division terminals, and not in connection with important repair shops, and those in connection with repair shops.

At outlying engine-houses we assume there would be no power-driven machines and suggest the following list of tools, the number and sizes to be determined by local requirements:

Twist drills.	Pipe cutters.
Drill sockets.	Jacks, sledges, drifts, crowbars, saws, brace and bits.
Taps — including machinists', steam-chest, pipe, wash-out, straight and taper, stay bolt.	Twist drills, extra long.
	Drill chucks.
Dies to correspond.	Ratchets and braces.
Pipe stock and dies.	Surfacer plates.
Hacksaws.	Tinners' bench shears.
Straight edge.	Reamers, rod and taper.
Flue tools—caulking, rolls, expanders, beading.	Wrenches, socket, crowfoot, hexagon.

In considering equipment for engine-houses at important division terminals not connected with repair shops, it is assumed there will be no dissent to the opinion these should be equipped with all such tools and appliances as will expedite the movement of locomotives through the house and keep them in first-class repair as far as this can be done without a backshop overhauling. It will take but little thought to convince the inquirer that the returns on capital wisely invested in such tools will make big returns when the resulting increased earnings of the capital invested in locomotives is considered, not only because of the time otherwise lost in going to, through and from the main shop, but, as well, the fact that locomotives sent to the main shop for specific repairs almost invariably receive more than these, the additional repairs not postponing the date of the final shopping and being almost inevitably made because of the training and point of view of the repair-shop forces—men and foremen—as mentioned in a preceding paragrah. Nor should it be forgotten that engine-house repairs will reduce the delays due to breakdowns and increase engine efficiency.

As local conditions vary and as conditions should largely determine facilities, it follows that the committee's recommendations can be only general. With this understanding, we submit the following suggestions. In general, we believe an engine-house should be equipped with driving and truck wheel drop pits and tools to take care of all necessary rod work, driving-boxes, ordinary valve-gear work and the replacing of flues needed between general overhaulings. In most cases it will be found that work of the nature indicated above can be done with but a very small addition to the engine-house force, because of the fact that, without this work, the men are, from the nature of the conditions, idle an appreciable part of the time. In line with this, some roads have found it economical to have always at the engine-house for general repairs an engine not needing heavy boiler work.

The list of tools suggested for outlying engine-houses, to be expanded to meet the requirements of a larger terminal:

Ample storeroom stock.	Hot-water washout facilities.
Drop pit for driving-wheels.	Drop pit for engine truck and tender wheels.
Double blacksmith forge, face plate and tools.	Portable blacksmith forges.
72-inch boring mill.	36-inch boring mill.
Driving-wheel lathe.	24-inch lathe.
38-inch tire turning lathe.	16-inch lathe.
Planer.	Shaper.
Slotter.	36-inch vertical drill.
Sensitive drill.	Emery grinder.
Bolt cutter.	Pipe-bending machine.
50-ton hydraulic press.	Punch and shear.
Power-driven valve-setting machine.	Air compressor.
Air hammers.	Air motors.

For engine-houses in connection with repair shops, the committee has not been able to agree. Several of the members feel that it is economical to depend on the main shop for considerable machine work. On the other hand, the other members believe that, except for tire turning, the equipment should be practically the same as for an independent engine-house, because of the saving of time and cost of repairs and the different training of engine-house and shop men.

Discussion.—It was the general opinion among those who discussed this paper that too much importance cannot possibly be associated with the question of providing the very best facilities, both in buildings and equipment.

F. F. Gaines (C. of Ga.) believes that in a large terminal the roundhouse should be entirely separated from the back shop, and with all necessary equipment to take care of the running repairs without having to depend on the back shop. He differed from the report in one respect, that it did not recommend any tool equipment at outlying points. Mr. Gaines thinks that wherever it is possible a drill press, lathe and a few other tools should be installed, and mentioned that electric power is generally available at outlying points through the city's lighting system.

C. E. Chambers (C. of N. J.) agreed with the committee on points of equipment of roundhouses, and when properly equipped considers it one of the best aids for proper back shop work. A. E. Manchester (C. M. & St. P.) and J. F. DeVoy (C. M. & St. P.) both agreed with the views entertained by the previous speakers and with the committee, that roundhouse men should be specialists.

R. D. Smith (B. & A.) believes that 60 per cent. of the maintenance of the locomotive should be expended in the engine house to insure the best road service, and 40 per cent. in the shop. He recommended the installation of drop pit sections made from 100 to 112 feet long, in order that an engine can be moved with the shop doors closed, to permit the dropping of any wheel.

E. W. Pratt (C. & N. W.) concurred with Mr. Smith in advocating the use of extra long drop pits, which is in line with the practice being followed on his road in later work. The fact that the modern freight terminal appears to have the consolidated engine in the majority, there are four pairs of tank wheels and one pair of engine truck wheels to be dropped. If the truck wheel pits have an extension permitting the movement of the engine any pair of tank wheels can be taken out, and the engine still kept inside the roundhouse walls in bad weather.

Mr. DeVoy (C. M. & St. P.) opposed the drop pit extensions in view of the expense for the necessary land in some cities, and expressed a preference for a wire rope engine haul operated by the turntable tractor.

In closing the discussion, Mr. Quereau said that it was not the intention of the committee to go into details, but simply to discuss the subject on its broad general grounds. The list of tools to be kept at a roundhouse was not intended as one that should be applied to all such plants, it being intended for use in roundhouses where there is no power. He is of the opinion that a road which does 60 per cent. of its repairs in the roundhouse and 40 per cent. at the back shop, will have its engines in better condition and at a less expense.

CONTOUR OF TIRES

Committee:—W. C. A. Henry, Chairman; O. C. Cromwell, J. A. Pilcher, O. M. Foster, A. C. Adams.

The Committee on the Contour of Tires has been instructed to give consideration to the following and make recommendations: The desirability of adopting the M. C. B. standard contour for engine-truck wheels, tender-truck wheels, driving and trailing wheels, also limit of wear of tread, shop and road limit of last turning, maximum height of flange, thickness of flange and gauges.

As the present standard contour for cast-iron wheels of the American Railway Master Mechanics' Association is identical with the 1909 standard of the Master Car Builders' Association, we are assuming that our instructions as to contour refer to steel and steel-tired wheels only.

Replies to our circular of inquiry indicate that the M. C. B. 1909 contour is being very generally used for engine-truck and tender-truck wheels. Some roads have already adopted this contour for flanged driving-wheel tires as well. We feel that this contour is desirable for all flanged wheels under locomotives and tenders for the same reason that it is desirable for car wheels, in addition to which is the feature of uniformity.

The present A. R. M. M. A. standards call for six widths of flanged tires, and five widths of plain tires, as follows:

Flanged tires....	5 in.	5¼ in.	5½ in.	5¾ in.	6 in.	6¼ in.
Plain tires......	6 in.	6¼ in.	6½ in.	6¾ in.	7 in.	

Replies from the manufacturers of steel tires indicate that of the flanged tires manufactured by them, there are practically but two widths, namely, 5½ inches and 5¾ inches, the large majority being the former. In the case of plain tires the prevailing widths manufactured are 6 inches, 6½ inches and 7 inches, there being little demand for the 6¼-inch and 6¾-inch widths. It is the opinion of the committee that one standard

for cast-iron and one for steel and steel-tired flanged wheels, namely, the M. C. B. 1909 standards, and three widths of the present A. R. M. M. A. contour for plain tires will meet all requirements and be to the advantage of all concerned, due to the fewer number of standards.

The prevailing limit of wear of tread or channeling for all we feel that the limits prescribed on the chart submitted as a portion of our recommendations will be suitable for roads not having severe grades, or extremely cold weather, and not using retaining rings. Where these conditions prevail, or retaining devices are used, such deviations will have to be made as experience indicates are desirable.

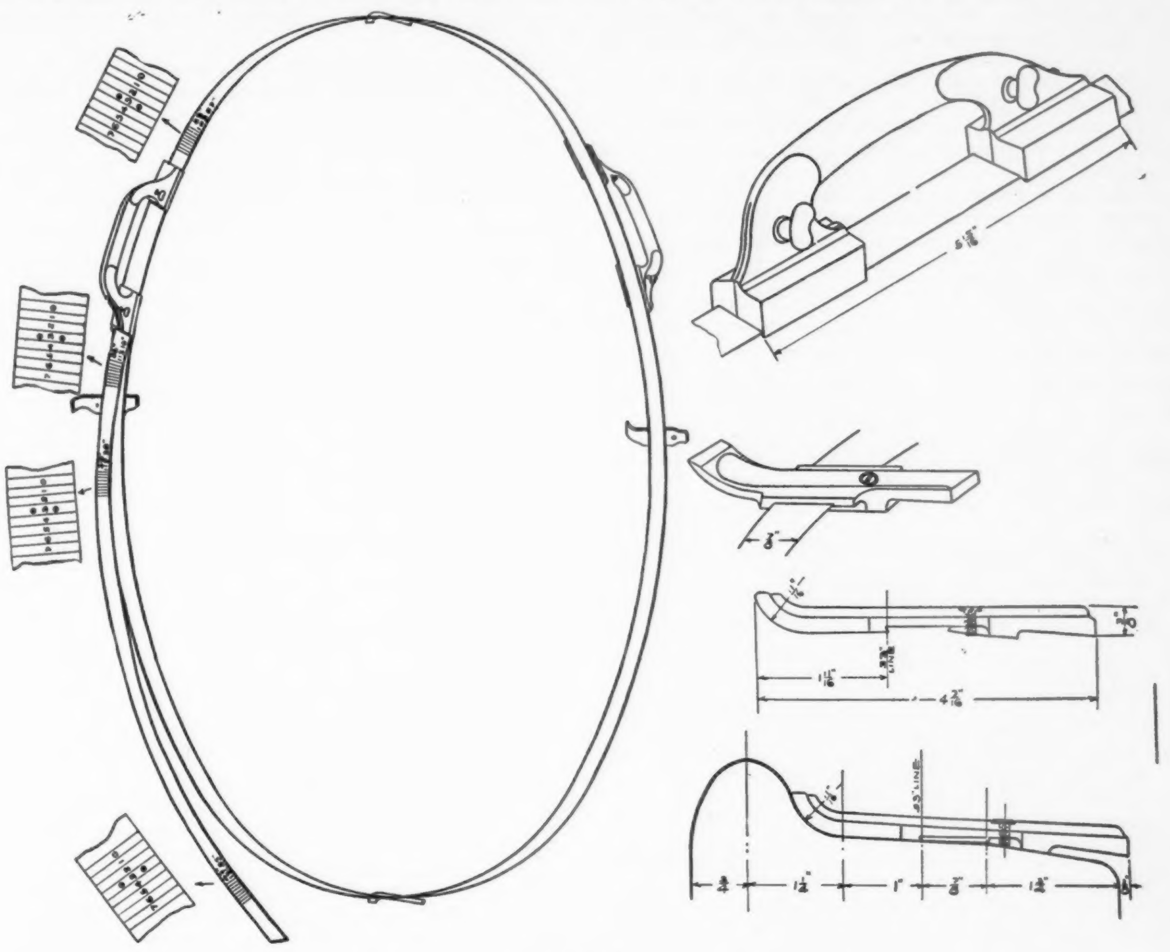
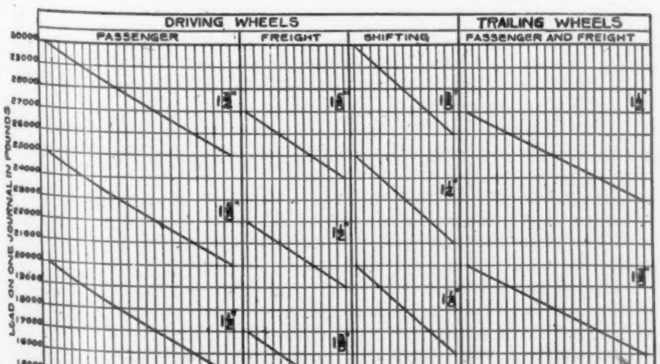


FIG. 1.

wheels under locomotives and tenders is 1/4 inch for locomotives in road service and 5/16 inch for locomotives in shifting service, which we feel is good practice.

In investigating the subject of limits of wear of driving-wheel tires we have found the greatest variation. After full consideration, it does not seem possible, or advisable, to establish a minimum road limit to be followed by all roads. Where long, steep grades necessitate heavy braking, or severe weather conditions result in frozen roadbed for long periods of time, tires cannot be worn to the same degree of thinness as where these conditions do not prevail. Also, the use of retaining rings, which practice, however, is not universal, has a bearing on tire thickness. After consideration of all the data available,

ROAD LIMITS OF TIRE WEAR FOR DRIVING AND TRAILING WHEELS VARIOUS CLASSES OF SERVICE - HELD BY SHRINKAGE ONLY.



The prevailing practice is to establish the shop limit of thickness of tires 1/4 inch above the road limit. This limit is strictly one of economy and not safety, and will vary with the facilities for doing the work. We, therefore, hesitate to recommend a definite shop limit.

The M. C. B. limit for thickness of tire or rim for steel and steel-tired wheels is being generally followed in the case of engine truck and tender truck wheels with satisfactory results, and the committee recommends the same limits be adopted.

The M. C. B. Association has already adopted a maximum height for flanges, of 1½ inches. This was considered the maximum height flange that would not, in service, damage track bolts, filler blocks, etc. There is no reason why this maximum height should be deviated from.

The question of gauges is one in which there is practically no uniformity, each road apparently having gotten up a gauge to suit its individual views. We are submitting recommendations for a shop or roundhouse gauge on which can be read direct the important dimensions; namely, channeling of tire, height of flange, and thickness of tire.*

It has been suggested that the number of brackets on standard wheel circumference measure be increased from three to four and the length of the brackets increased so as to project 1/8 inch beyond the rim when brackets are in proper position. The present method of graduating the circumference measure does not provide a definite boundary for each tape size, as the tape sizes are indicated by lines.

It is, therefore, recommended that instead of defining tape sizes by lines they be defined by spaces. The committee is of the opinion that these changes in the size and number of brackets, as well as the markings of the circumference measure, all of which are shown on Fig. 1, are desirable.

RECOMMENDATIONS.

We recommend the M. C. B. 1909 contour for all flanged steel or steel-tired wheels, as follows:

(a) Engine truck.
(b) Tender truck.

* Illustration not reproduced because of blurred condition.

(c) Driving wheels.
(d) Trailing wheels.

Plain tires to be of three widths, namely, 6 inches, 6½ inches and 7 inches, the contour to be the same as the present standards; the widths of 6¼ inches and 6¾ inches to be eliminated.

Limit of wear of tread or channeling to be as follows: ¼ inch for all locomotive and tender wheels in road service; 5/16 inch for all locomotive and tender wheels in shifting service.

Road limit for driving and trailing wheels to be as specified in the chart.

Road limit for steel and steel-tired wheels for engine and tender trucks to be the 1909 recommended practice of the M. C. B. Association.

Maximum flange height to be 1½ inches.

Wheel circumference measure to be modified as per Fig. 1.

Discussion.—There was a very active discussion pro and con on the matter of the height of flange and the advisability of using the taper tread. Members reported in favor and against both practices to so great a number that the subject was finally disposed of by referring it back to the committee with instructions to investigate the subjects mentioned more fully and report next year.

LUBRICATION OF LOCOMOTIVE CYLINDERS

Committee:—C. H. Rae, Chairman; Jos. Chidley, T. R. Cook, J. F. DeVoy, J. F. Walsh, S. T. Park, P. M. Hammett.

A number of questions were submitted to members, the replies to which contained the following information:

There is no serious difficulty now experienced in lubricating modern passenger and freight locomotives with the "up-to-date" lubricators of the hydrostatic-feed type.

Several of the members referred to a recent improvement in the hydrostatic lubricator, whereby it is made possible to close or shut off feeds without interference with the feed-valve adjustments. This is an economical feature, but of such recent date that no comparative data have been submitted as to the results obtained. One member replies in regard to devices which increase the efficiency of hydrostatic lubricators as follows: "The automatic steam-chest choke plugs, which feed against a constant boiler pressure in the oil pipe, and not against a pressure that fluctuates with pressure in steam chest, will result in a high degree of efficiency in the lubricator."

The replies to questions concerning mechanically operated lubricators were limited in number. Following are quotations from several:

"Have used several types of mechanically operated forced-feed lubricators. Three of those experimented with were driven from a moving part of the engine. This was unsatisfactory, since the feed is required that does not vary with the speed of the engine. More oil is required per minute while the engine is worked hard at low speeds than when running fast with light throttle. To overcome this we used some forced-feed lubricators with independent air motor. None of them, however, have been satisfactory. It is difficult to apply to the filling holes screens that are fine enough to keep out dirt, without restricing he speed at which the oil can be put in, and the enginemen pull them out. The consequence is that the plungers wear rapidly, and after a time the feed becomes irregular. They are troublesome to maintain, and under conditions specified, in answer to question No. 1, gave no better results than the hydrostatic lubricator.

"We have experimented with two or three makes of mechanical-feed lubricators, but have been unsuccessful in getting as good results as we do with the hydrostatic-feed lubricators. The trouble with the mechanical-feed lubricator seems to be due to the difference in temperature; in warm weather, or during the warm part of the day, they would feed sufficient oil, but in cold weather, or at night when the weather is colder, they do not feed as well as when it is warmer."

"We have used two mechanical lubricating devices, which received their motion from a connection made to the valve stem and oil chamber, and regulating devices were located in the cab. Our test record shows that after considerable experimenting the device operated fairly well, but after a time gave considerable trouble and was finally removed on account of not giving satisfactory results. Mechanical means are objectionable, in that the device is so complex, and consists of so many parts, it is difficult to keep joints from leaking. To be properly installed, all pipes must be kept constantly filled and under pressure, with return valves at distributing points. On account of mechanical movements, parts will wear, and it will be more expensive to maintain, and in making repairs more oil is lost than with hydrostatic lubricators. Devices of this sort do not appear to have as yet been perfected to such an extent as to make them thoroughly reliable."

"Have used a force-feed lubricator with pipe connections to all driving boxes and to steam chest. Operated by mechanism deriving its motion from connection to Walschaert link. Lubricator located in the cab.

"While reducing friction on journal bearings, and delivering oil to steam chest, I do not consider it entirely satisfactory, for the reason that there is nothing to indicate that the pumps are working properly and delivering the oil until the valves become dry."

"Our objections to mechanically operated lubricators is that they are necessarily more complicated than the hydrostatic lubricator, without showing any beneficial results."

"Have tried some, but have not obtained satisfactory results."

"We have in the past used on some of our two-cylinder compound engines mechanically operated lubricators. Our objection to it was the rapid wear of the parts, leakages and annoyances."

"Using displacement plunger force feed. Secured in suitable location in cab, and operated by a series of rods and bell cranks, which are connected, either to eccentric blades and independent eccentric on rear, or other convenient axle, or by reducing-arm on back crank pin. Device subject to varying control, and fed by increasing or decreasing stroke of plungers by means of adjustment thumb-nut.

"Results as to economy and distribution very satisfactory. Slight trouble experienced in experimental stage, due to method of operating lubricator."

In reply to questions concerning experience with admitting oil into the steam before it reaches the steam chest, the following information was given:

"Present method in use with mechanically operated lubricator is to tap direct through dome into steam pipe, or throttle box. This method has proven to be superior to the old method of admitting to steam chest direct."

In this connection, a member refers to a test:

"Delivering the oil from the right side of the lubricator into the left cylinder, passing it through the smoke box, and from the left side of lubricator into the right cylinder in the same manner.

"The gases in the front end superheating the oil, and evaporating the water of condensation, putting the oil into the cylinders superheated."

Questions Nos. 9 and 10, in reference to superheater locomotion, have been considered jointly by the members. In the information submitted, the important features of this phase of the subject are well expressed in the following quotations:

"Superheat varies from 550 to 580 degrees. Our regular practice is to use one feed pipe to valve chest, applying it to go to each end of valve in center of the valve bushing. This lubricates valve very well, but it is questionable whether delivering oil to steam passage is not preferable. We also use one feed to each side of cylinder, at top in center. This is not used unless required. When working with full throttle and long cut-offs, over considerable distances, find cylinder feed necessary.

"There is no difficulty whatever in obtaining satisfactory lubrication in superheater engines with hydrostatic lubricators, on account of difference of pressure between steam chest and boiler, previously mentioned. In fact, there is considerably less difficulty than on engines using saturated steam. In spite of this the piston-ring wear is far more rapid."

"On our superheaters we carry 170 pounds boiler pressure; the maximum degree of superheat is 225. On a number of superheater engines we introduced oil both at the steam cavity and into the cylinder direct; found the latter connection unnecessary.

"The only trouble which we had with superheater engines was to get our men to use the drifting valve when the engine was shut off. If this is not done, have experienced trouble with the bushings cutting out, but on districts where the drifting valve is put on we are having very good success."

All replies to the question concerning lubrication of Mallets pertain to the satisfactory use of the hydrostatic lubricator. No information furnished concerning use of mechanically operated lubricators on Mallet compound locomotives using superheat.

Replies to question No. 12 were at variance as to the location of the oil pipes, but it was the consensus of opinion that piping to the high-pressure valves and cylinders only was insufficient for satisfactory lubrication of Mallets.

The experience of the committee, supplemented by the information received from the members of the Association, warrants the assertion that there is no serious difficulty now experienced with the use of the hydrostatic-feed lubricator.

The recent addition of a stop-feed feature is an improvement, rather tending to economical operation than to efficiency, and it behooves the manufacturers of this device to keep pace with, or in advance of, the constantly increasing demands.

The information obtained from the members, and cited in the foregoing, confirms the experience and opinion of the committee, that a properly constructed hydrostatic lubricator meets the locomotive requirements better than a mechanically operated lubricator, for the several reasons:

(1) Familiarity with care and operation by the different classes of labor whose duties are in connection with its use.

(2) Simplicity of design and substantial in construction; the operating parts being better protected from disarrangement or breakage.

(3) A more accurate regulation of the amount of oil applied to the valves and cylinders under the varying conditions of service performed by the locomotive at different speeds and points of cut-off.

(4) Because of less complication in construction and attachments, a corresponding less expense of maintenance.

The more general custom of delivering the oil to the steam chest or valve chamber is open to question, and there has been some very conclusive evidence submitted favoring the delivery of the oil into the steam at a point where it may become highly attenuated and intermingled with the steam.

The presumed effect of extreme temperatures, due to high pressure and superheat upon the oil, has been an objection to delivering the oil in the steam before it reaches the cylinder saddle. Information has been furnished and confirmed by the experience of some of the members, that the efficiency of a properly compounded mineral cylinder oil is not seriously impaired when protected by the steam.

As the reports on this particular feature of the subject are indefinite, the committee recommends further consideration and experimentation.

The information obtained from the members who have had the most general and extended experience with locomotives using superheated steam confirms the experience and opinion of the committee, i. e., that the same reasons advanced for the endorsement of the hydrostatic-feed lubricator on locomotives using saturated steam apply to locomotives using superheated steam.

The information submitted and quoted in the replies, pertaining to the proper location and number of oil pipes on superheated locomotives, is of much value. The experience thus far is not sufficiently conclusive to justify a decisive recommendation at this time.

We would, however, particularly recommend that liberal openings be given to drifting valves, and attention to their proper manipulation, that the temperature of the cylinders may be promptly reduced within the lubricating possibilities of the oil when exposed to the atmosphere.

The problem of satisfactorily lubricating the Mallet compound locomotive is still in process of solution. At present it seems essential to pipe independently to the high and low pressure cylinders. However, the committee has been advised that there has been some experience, with satisfactory results, by eliminating the pipes to the low-pressure valves and cylinder, substituting an auxiliary oil pipe to the receiver with the high-pressure steam connection. This carries sufficient oil over to the low-pressure cylinders to insure good service.

Increased efficiency and reduced expense of operation confronts the mechanical departments of our railways to a greater extent than ever before.

Discussion.—There was practically no discussion accorded this paper. George L. Fowler said that the Long Island Railroad has been experimenting for the last six or eight months with a mechanical lubricator for cylinders in wich a mixture of oil and graphite is pumped into the cylinder, operated mechanically, and after a run of about two hundred miles the faces of the steam chests, valves and cylinders become coated with the film of graphite, and the operation has been found very successful and satisfactory.

E. A. Miller (N. Y. C. & St. L.) finds that very good results can be obtained by applying the graphite at the commencement of each trip to a cup, separate from the lubricator, and applying this graphite cup to the steam chests in addition to the regular lubricator.

George A. Hancock (St. L. & S. F.) said that his road had 50 engines with the steam temperature about 535 to 565 degrees, and that the mechanically operated lubricator had proved unsatisfactory. Instead of admitting oil directly through the cylinder and valve, Mr. Hancock said that the practice now being followed on the 'Frisco is to connect the oil pipes direct to the steam passage. This in connection with a small amount of graphite gives satisfactory service. He added that the oil allowance was one pint of valve oil for every forty miles on freight service, and one pint for every sixty miles on passenger service.

CONSOLIDATION

D. F. Crawford, chairman, reported that the committee had investigated and found there were no legal reasons to prevent the consolidation of the two associations. The motion of H. T. Bentley that the committee be continued was carried.

REPORT OF COMMITTEE ON MAIN AND SIDE RODS

Committee:—W. F. Keisel, Jr., chairman; H. Bartlett, G. Lanza, H. B. Hunt, W. E. Dunham.

The following is submitted as a progress report, with the request that every member of the Association send the committee criticisms or suggestions for modifications before February 1, 1912. The data already furnished by the members form a very interesting study. The first part of the subject relates to kind of material in rods. There is very little difference in the steel for rods, and open-hearth steel having an ultimate tensile strength of 80,000 pounds per square inch is used by all railroads. There is some variation in the chemistry. Special alloy and heat-treated steels have been considered and put in service, but, to date, information relating to such steels in rods is too meager to justify recommending their use. The second part of the subject relates to specifying formulæ for checking up sizes and designs of main and side rods.

1. MAIN RODS.—The rod bodies are subject to the following strains:

First: Tension and compression, due to piston pressure and inertia of reciprocating weights.

Second: Bending, caused by centrifugal force acting vertically.

Stresses from compression are always more than from tension.

Reciprocating parts are made as light as possible, and stresses due to inertia of reciprocating weights are usually less than those created by cylinder pressure. Furthermore, when drifting, the amount of retardation, due to vacuum and compression in the cylinder, will, to some extent, balance the inertia strains. If for passenger and high-speed freight locomotives the maximum piston pressure is less than the product of the reciprocating weights by four times the crank length in inches ($P < 4rW$) the latter value ($4rW$) should be used in place of maximum piston pressure. For slow freight and shifting engines, such substitution is not necessary. From the above it will be noted that the calculations may be confined to a consideration of rod body as a strut, with load equal to the piston pressure, or its substitute, and as a beam subject to bending on account of whip action at high speeds.

2. SIDE RODS.—The rod bodies are subject, first, to tension or compression arising either from a part of the piston pressure transferred through main crank pin, or from a requirement for the rod to slide one or more of the driving wheels, and second, to bending caused by centrifugal force acting vertically. When all drivers are not of exactly the same diameter, and when the locomotive is passing over curves, the side rods must slide drivers. The limit of the force to slide drivers is governed by the coefficient of friction between wheels and rail. The commonly accepted coefficient of friction when calculating tractive power, is .25, or less. For our purpose it should be somewhat higher, to be on the safe side. A number of builders and roads use the coefficient .3, which fully meets the requirements.

For starting, we assume that each rod must be capable of sliding the *pairs* of drivers to which it imparts rotation, but when running at speed it must slide the drivers on one side only. Therefore, the value P in Professor Lanza's formula would be

$$P = \frac{WR}{r} \text{ for starting.}$$

$$P = \frac{WR}{2r} \text{ for running at speed, in which}$$

W=Weight on pairs of drivers receiving rotation from the rod.

R=Radius of wheel.

r=Radius of crank.

As stated at the beginning, most roads base calculations of rods on a speed of 336 revolutions per minute. This is high for some engines, such as Mallet compounds, and low for fast passenger engines, some of which now reach a greater speed, and the tendency is to achieve still greater speed. The use of 375 revolutions per minute, for fast freight engines and passenger engines, and 420 revolutions per minute for fast passenger engines would be sufficiently high for ordinary locomotives. For Mallet compounds, and other very slow locomotives, a special figure may be taken.

3. RODS AS STRUTS.—Main rods are almost invariably made taper, and the section, if fluted, may vary in thickness of flange, height of web, thickness of web, or a combination of two, or all three. The taper is never of such amount that the results are appreciably affected if calculations are based on the section at the center, the same as for rods having a uniform cross-section. Good practice indicates that this center area for all rods should not be less than maximum assumed end load divided by 10,000 pounds. Merriman's Rational Formula for columns (see Kent's Pocket Book) is:

$$C = \frac{B}{1 - \dfrac{nB}{\pi^2 E}\,\dfrac{L^2}{r^2}}$$ in which

B=Unit load.
C=Maximum compression unit stress.
L=Length of column.
r=Least radius of gyration.
E=Coefficient of elasticity.
n=1 for both ends, round.
n=¼ for both ends, fixed or flat.

If we have a unit stress of 10,000 pounds per square inch, the value of length divided by least radius of gyration ($L \div r$) must not exceed eighty (80) for neutral axis vertical or parallel with side of rod, and not more than one hundred and sixty (160) for neutral axis horizontal. For these values the maximum compression unit stress is 12,710 pounds per square inch, or slightly within the assumed figure for maximum allowable stress of one-sixth of the ultimate tensile strength.

With neutral axis vertical for rods having rectangular section $r = b \sqrt{12}$ ("b" being the depth of section). Substituting this in $L \div r = 80$, we get $L = 23b$. Therefore, if the length from center to center of pin is less than twenty-three (23) times the depth of a rectangular rod, the value $L \div r$ is less than 80. Similarly with neutral axis horizontal $r = a \div \sqrt{12}$ ("a" being width of rod) and the value $L \div r$ is less than one hundred and sixty (160) when L is less than forty-six (46) times the width of section.

4. OFFSET RODS.—A number of the rods are offset, that is, the vertical center line of the bearings at the end do not lie in the same plane, or in the plane of the center line of rod body. The greatest offset given is 1 13-16 inches. This creates a bending strain and increases the stress in the rod body. The added stress from this source is equal to the product of the maximum end load and the offset, divided by the section modulus with axis vertical, and requires a correspondingly larger section modulus.

5. SIDE RODS WITH KNUCKLE JOINTS.—Rods for three and four coupled locomotives must be provided with knuckle joints. The knuckle joints are all necessarily flexible vertically, and some are flexible horizontally also. When the drivers on one side are not in perfect horizontal alignment, slight bending strains occur, in addition to the compression strains. To take these bending strains into consideration would complicate the formulæ. The end pressures on the rods being based on driver weight and a coefficient of friction greater than that expected, the margin in this assumption is sufficient to compensate for the bending strains arising from the non-alignment of the drivers on the one hand, and the deflection of the rod due to centrifugal force, when running at high speed, on the other hand; therefore, both bending strains may be ignored for the purpose of simplifying the final checking formulæ. When running at speed the centrifugal force from the short rod connected to the extension of the long rod reduces the bending strains due to centrifugal force in the long rod. As the extension to the long rod is short, this effect may also be ignored as the possible reduction in weight of long rod would not be appreciable. When the drivers, due to wear between hubs and boxes, etc., are not in vertical alignment, bending strains are induced. Knuckle joints are at times made flexible transversely, in addition to the vertical flexibility, for the purpose of eliminating the bending strains. For locomotives on which a large amount of side play is allowed to accumulate, this transverse flexibility is of great value, to avoid rod failures. When the knuckle joints are flexible in both directions, the value of $L \div r$, for the short rods, should be one hundred and ten (110), instead of one hundred and sixty (160), given in No. 3 (rods as struts).

6. BENDING STRAINS DUE TO WHIPPING, AT HIGH SPEED.—For main rods the point of maximum bending strain is always very close to six-tenths of the length from crosshead end. This statement is based on the examination of a large number of rod designs. The section at this point may, therefore, be taken as the governing section. For side rods the point of maximum strain is at the center.

7. SIMPLIFICATION OF FORMULÆ.—As accurate calculations are rather lengthy, and must necessarily be based on conditions representing extremes, simple formulæ giving values within a very small per cent. of those obtained by the more accurate method are better adapted for the purpose and especially useful for checking. The basis for bending strains at speed is centrifugal force (F). If G represents the weight, considered in pounds, and r represents the crank radius, in inches, then

Centrifugal force	=	2Gr	3Gr	4Gr	5Gr for
Number of revolutions per minute		265	325	375	420

A cubic inch of steel weighs closely .2833 pounds. Both main and side rods may be considered as having a uniform section, equivalent to the governing section and extending from pin to pin. This assumption is accurate for side rods, but for main rods gives stresses at high speeds, possibly one per cent higher than those found by the accurate method.

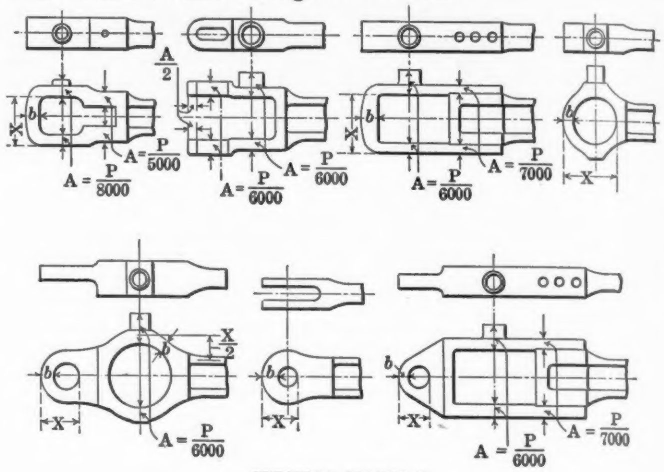
If A=Governing area of rod, in square inches
and L=Rod length, center to center of pins, in inches,
then $G = .2833\ AL$
and $Gr = .2833\ ALr$.

For side rods the bending moment $M = .125FL$.

The formulæ for bending moment (M) for main rods and side rods, at the assumed speeds, are noted in the following tabulation:

Revolutions per minute	265	325	375	420
"M" for main rods.	$.036AL^2r$	$.055AL^2r$	$.073AL^2r$	$.091AL^2r$
"M" for side rods..	$.071AL^2r$	$.106AL^2r$	$.142AL^2r$	$.177AL^2r$

From the above, the stress due to whipping action may be found by means of the well-known formula, $M \div SM$=Stress, to which the stress due to end strains, assumed as maxima, must be added. The sum of these stresses should not exceed one-sixth of the ultimate tensile strength of the steel.



CHECKING FORMULAE.

All measurements are given in inches and pounds.
A = Area of section considered.
a = Width of section considered.
b = Depth of section considered.
C_1 = Max. compression unit stress for transverse bending.
C_2 = Max. compression unit stress for vertical bending.
$c = c_1 - c$ = coefficients.
d = Cylinder diameter.
L = Length of rod from centre to centre of pins.
M = Bending moment.
P = Max. compression strain acting at end of rod.
p = Max. boiler pressure.
Q = Cylinder pressure = $0.7854\ d^2\ p$.
R = Radius of driving wheels.
r = Radius of crank.
RG = Radius of gyration of section — axis horizontal.
rg = Radius of gyration of section — axis vertical.
S = Stress — and where used in formulæ must not exceed one-sixth of ultimate strength of the steel.
s = Amount of horizontal offset in rod.
SM = Section modulus of section considered — axis horizontal.
sm = Section modulus of section considered — axis vertical.
W = Weight on pairs of drivers actuated through rod considered.
Main rod area must not be less than $P \div 10{,}000$ lbs.
For main rods P = Q.
For side rods $P = \dfrac{0.3\ WR}{r}$

To determine C_1 and C calculations should be based on a section half way between rod pins.

For transverse bending in rods having knuckle pins flexible transversely

$$C_1 = \frac{\dfrac{P}{A}}{1 - \dfrac{PL^2}{675{,}000{,}000\ A\ rg^2}}$$

For all other rods

$$C_1 = \frac{\dfrac{P}{A}}{1 - \dfrac{PL^2}{1{,}200{,}000{,}000\ A\ rg^2}}$$

For vertical bending in all rods

$$C_2 = \frac{\dfrac{P}{A}}{1 - \dfrac{PL^2}{300{,}000{,}000\ A\ RG^2}}$$

Values for C_1 and C_2 can also be taken from tables in "Kent's Pocket Book" under heading "Merriman's Rational Formula for Columns."

First—

For rods without offset the larger value of C_1 and C should be taken equal to S.

For rods with offset the larger value of $C + \dfrac{Ps}{sm}$ and C_2 should be

Second—

$$S = c\frac{AL^2r}{.SM} + c\ P\left(\frac{I}{A} + \frac{s}{sm}\right)$$

The calculations should be based on a section located at a distance 0.6 L from crosshead pin for main rods, and half way between pins for side rods.

VALUES OF C AND C

Rev. Per Min.		265	325	375	420
Main Rod	$C =$	0.036	0.055	0.073	0.091
	$C_1 =$	0.500	0.500	0.400	0.300
Side Rod	$C =$	0.071	0.106	0.142	0.177
	$C_1 =$	0.500	0.500	0.500	0.500

The coefficients selected should correspond with the highest number of revolutions per minute which the locomotive can make.

If this cannot be determined, use
420 R.P.M. for high speed passenger locomotives.
375 R.P.M. for passenger and high speed freight locomotives.
325 R.P.M. for all other locomotives.

Very simple rules for rods, without offset, and having bodies with rectangular section, based on the above theory, follow.

First—

Stress is less than one-sixth of ultimate strength of the steel if "L" is less than 46 "a" or 23 "b" and if "A" is more than "P" divided by one-eighth of ultimate strength of the steel.

Second—

$$S = C_2\frac{L^2 r}{b} + C_1\frac{P}{A}$$

VALUES OF C_2 AND C_1

Rev. Per Min.		265	325	375	420
Main Rod	$C_2 =$	0.22	0.33	0.44	0.55
	$C_1 =$	0.50	0.50	0.40	0.30
Side Rod	$C_2 =$	0.43	0.64	0.85	1.06
	$C_1 =$	0.50	0.50	0.50	0.50

The allowable stresses for the various sections of rod ends are given in connection with the diagrams above, except where thickness of section is indicated by the letter "b." The figures denote maximum stress allowed under end load "P." If the minimum areas of the two members differ, take double the lesser area for "A."

The minimum area at points indicated by letter "b" should be—

For main rods— $A = \frac{PX}{30{,}000\ b}$

For side rods— $A = \frac{PX}{60{,}000\ b}$

In which "X" is the average diameter of eye or average spread of jaw members.

Discussion.—This report was most appreciatively received by the members, and much valuable experience followed in the discussion. The most interesting features of the latter were in regard to the relative merits, or immunity from breakage of I section and rectangular section rods, and the practicability of forging fluted rods.

In this latter connection F. F. Gaines (C. of Ga.) said that he is developing a scheme to remedy the difficulty suggested by H. T. Bentley (C. & N. W.) of being obliged to mill out the very best part of a new rod to obtain the channel. Mr. Gaines explained that he has a forging press, a very slow action hydraulic machine, which works the metal to the center and expected to obtain very satisfactory rods by its use.

J. A. McRae (M. C.) said that he had discarded I section rods for all low speed engines, such as those engaged in freight service, the practice being to smooth forge them. This accomplishes the purpose of not cutting out the good metal, and the speaker added that they have obtained very good results from rectangular forged rods.

President C. E. Fuller mentioned that the question of forged fluted rods is a very old one, it being done with light engines when he was connected with the Central Vermont Railroad in 1892. A large number of its engines were equipped with fluted rods, forged without any machinery other than the bush centers. The results were excellent, but whether they would carry out with the heavier type is a question, as the rod is now so much heavier and larger that it would make quite heavy forging.

D. R. MacBain (L. S. & M. S.) said that after considerable experience on the New York Central lines with the various types of rods, fluted and otherwise, the conclusion has been practically reached that for all slow speed engines the rectangular section is by far the best proposition.

R. Patterson (G. T.) stated that a great deal of trouble had been in evidence on his road with fluted rods breaking, and the rectangular rod was substituted. He is confident that the latter will give much better service.

Mr. Kiesel in closing the discussion requested the various members of the association to let the committee hear from them by Feb. 12, after they have had a chance to look the report over more thoroughly and compare it with their own practice, and to advise the committee, particularly whether they consider the stresses allowed in the report as checking stresses are too high.

DESIGN CONSTRUCTION AND INSPECTION OF LOCOMOTIVE BOILERS

Mr. Seley reported for the committee as follows:

The committee is unable to present a written report on account of late date of promulgation by the commission of the boiler inspection rules.

Last year, due to legislation in Congress, it was thought wise for the association to put itself on record, so far as it could out of convention, in regard to getting out a set of rules covering minimum requirements of boiler inspection. The committee met and got out such a set of rules, and sent them out in a circular dated September 8, 1910. These rules were submitted to the membership. They concluded with a request for an informal ballot to get the mind of the Association, and they were carried practically unanimously, the negative votes being insignificant in number. These rules were brought to the notice of those handling the legislation, and, after the law had been passed the railways were invited by the chief boiler inspector to send representatives to a conference at Washington to discuss the matter of the rules, and a Conference Committee of mechanical officers—appointed as a sub-committee of the Special Committee on Relations of Railway Operation to Legislation—discussed the matter with the inspectors and the representatives of the employees, arriving at a set of rules with which you are probably familiar through Bulletin No. 17 of the Special Committee. Those rules were revised and finally acted upon at a hearing before the Interstate Commerce Commission on May 29, and were issued, with the ruling of the Commission, under date of June 2, 1911, and they have been distributed to the railways.

This ruling of the Commission and the rules which have been materially changed from those in the above-mentioned Bulletin, No. 17, are given as follows:

Whereas the fifth section of the act of Congress approved February 17, 1911, entitled "An act to promote the safety of employees and travelers upon railroads by compelling common carriers engaged in interstate commerce to equip their locomotives with safe and suitable boilers and appurtenances thereto," provides, among other things, "that each carrier subject to this act shall file its rules and instructions for the inspection of locomotive boilers with the chief inspector within three months after the approval of this act, and after hearing and approval by the Interstate Commerce Commission, such rules and instructions, with such modifications as the commission requires, shall become obligatory upon such carrier: *Provided, however,* That if any carrier subject to this act shall fail to file its rules and instructions the chief inspector shall prepare rules and instructions not inconsistent herewith for the inspection of locomotive boilers, to be observed by such carrier; which rules and instructions being approved by the Interstate Commerce Commission, and a copy thereof being served on the president, general manager, or general superintendent of such carrier, shall be obligatory and a violation thereof punished as hereinafter provided," and

Whereas at the expiration of the period of three months after the approval of said act many of the common carriers subject to the provisions thereof had failed to file their rules and instructions for the inspection of locomotive boilers with the chief inspector; and

Whereas the chief inspector thereupon proceeded to prepare for submission to the Interstate Commerce Commission for its approval rules and instructions for the inspection and testing of locomotive boilers and their appurtenances for such carriers so failing to file the same; and

Whereas upon due notice there came on a hearing before the Interstate Commerce Commission in the matter of the approval and establishment of the rules and instructions prepared by the said chief inspector, on the 29th day of May, 1911; and

Whereas such carriers as had filed their rules and instructions for the inspection and testing of locomotive boilers and their appurtenances with the chief inspector within three months after the passage of said act asked, through their representatives at said hearing, that such of said rules and instructions which did not fulfill the requirements of the proposed rules and instructions prepared by the chief inspector be modified to the extent necessary to conform thereto, and that such of said rules and instructions as prescribed a higher standard than that required by the rules and instructions prepared by the chief inspector be regarded as withdrawn from consideration, and joined in a request that such rules and regulations as had been prepared by the chief inspector and approved by the Interstate Commerce Commission be established with uniformity for them and all other carriers subject to the act; and

Whereas at the hearing aforesaid the rules and instructions prepared by the chief inspector were submitted to the Commission for its approval and all parties appearing at said hearing were fully heard in respect to the matters involved, and said proposed rules and instructions having been fully considered by the Commission:

It is ordered, That said rules and instructions for the inspection and testing of locomotive boilers and their appurtenances, as follows, be, and the same are hereby, approved, and from and after the 1st day of July, 1911, shall be observed by each and every common carrier subject to the provisions of the act of Congress aforesaid as the minimum requirements: *Provided,* That nothing herein contained shall be construed as prohibiting any carrier from enforcing additional rules and instructions not inconsistent with the foregoing, tending to a greater degree of precaution against accidents:

Flues to be removed.—All flues of boilers in service, except as otherwise provided, shall be removed at least once every three years, and a thorough examination shall be made of the entire interior of the boiler. After flues are taken out the inside of the boiler must have the scale removed and be thoroughly cleaned. This period for the removal of flues may be extended upon application if an investigation shows that conditions warrant it.

Method of testing rigid bolts.—The inspector must tap each bolt and determine the broken bolts from the sound or the vibration of the sheet.

If stay-bolt tests are made when the boiler is filled with water, there must be not less than 50 pounds' pressure on the boiler. Should the boiler not be under pressure, the test may be made after draining all water from the boiler, in which case the vibration of the sheet will indicate any unsoundness. The latter test is preferable.

Flue plugs.—Flue plugs must be provided with a hole through the center not less than three-fourths inch in diameter. When one or more tubes are plugged at both ends the plugs must be tied together by means of a rod not less than five-eighths inch in diameter. Flue plugs must be removed and flues repaired at the first point where such repairs can properly be made.

Leaks under lagging.—If a serious leak develops under the lagging, an examination must be made and the leak located. If the leak is found to be due to a crack in the shell or to any other defect which may reduce safety, the boiler must be taken out of service at once, thoroughly repaired, and reported to be in satisfactory condition before it is returned to service.

The order is pretty clear. Without having had any legal advice in the matter I will say that as I understand it the railways that have filed rules have withdrawn them, and all the railways in the country will work under the set of rules which are attached to the order. In our own case we will make these rules supplement the rules of the railways for a reason which will appear later. The changes in the rules which are issued with the order, as compared with those which were handed to the Commission at the hearing, are in the arrangement of the rules in regard to the numbering of them; there are two minor changes in the wording, and one change in the arrangement, the Accident Report Rule being moved from its location in the former set of rules. None of these are, I believe, objectionable.

The order of the Commission includes copies of the report forms. It is desired that the railways print their copies of the monthly and annual reports of the identical size and the same arrangement as in the samples in order to have a similarity of reports for convenience of filing. There is no size given for the Quarterly Inspection Report or Cab Card. A number of us, however, are of the opinion that it is desirable to print it half the size of the other standard reports, which are 6 in. x 9 in., and half of that would be 4½ in. x 6 in. Some of our Chicago roads are working towards a standard card holder, so as to get it a matter of commercial manufacture in large quantities and at cheaper prices. The report also includes a Specification Card for locomotives, which will keep our mechanical engineers busy figuring out the dimensions and the strengths of present locomotives. The order concludes with a copy of the law.

Rule 12 reads as follows: "Any boiler developing cracks in the barrel shall be taken out of service at once, thoroughly repaired, and reported to be in satisfactory condition before it is returned to service."

As I would interpret that rule: These reports are our own, and we are not required to report repairs to the inspectors.

Tesing Boilers: Rule 17 to 20. These rules cover the annual test, and there are a great many items in the report which have to be filled in.

The monthly and the annual forms of reports have diagrams on their backs for filling in as to defective stay-bolts, but these are only the bolts which are allowed to run; therefore, any railway which desires to have a complete record of its stay-bolts will have to maintain its present boiler inspection forms, provided such forms carry with them diagrams of the broken stay-bolts. In our own case we will retain our Rock Island form and do our work just the same as we have heretofore, supplementing it with the government requirements.

Discussion.—It was very clear that this important Federal law is expected to result in considerable embarrassment to many of the railroads before a smooth and satisfactory working has been attained wherein all of the provisions may be carried out without delaying the handling of power. Many of the disputed points, however, were cleared up by Mr. Seley in closing the discussion.

D. F. Crawford (Penn) said that everything possible should be done in good faith to co-operate and assist the Federal and the State inspectors. He feels that it is possible to do a great deal with the gentlemen on the various State commissions to get them to adopt and use a Federal quarterly inspection card as covering the whole situation, the reports to be sent to the commission as may be decided by the various legal departments. Mr. Crawford added that inasmuch as the Federal Inspection Rules become effective July 1, time does not permit to refer the question of the size of the cab cards to the Committee on Standards, and moved that the association adopt as recommended practice the size 3 in. by 5 in., the library card size which will enable a copy to be kept, if desired, in the regular card catalogue file, which motion was put and carried.

R. D. Smith (B. & A.) mentioned that no particular trouble has been experienced on his road in carrying out this law, which is practically that of New York State under which he is operating, saying in part:

As I read this law, we will be obliged to have the certificates in the cab under glass, the same way that we now carry the certificate of the New York State inspection. It would seem to me, and I hope that some time action will be taken by this Association to that end, that it would be a good thing in some way to have the federal laws supersede the state laws. Our roundhouse clerks are notaries public and the inspectors go before them and make out their inspection reports, and they are sworn to and forwarded in the regular way. This is not done at one time, but it is a continuous performance. It goes on daily, and it goes on at night as well as in the day time. In engine houses where we have a large number of engines the night clerks are notaries as well as the day clerks. The copy of the law did not reach my desk until just as I was leaving the office, and I am not familiar with the time which we are to be given to fill out the specification cards for boilers. Of course, those of us who have had engines running in the State of New York can get copies of those specification cards, which will make very much less work than stated by Mr. Seley is necessary, but I do know how much time we have in which to file these cards.

The report was also discussed by Messrs. Haig (A. T. & S. F.), Enright (D. & R. G.), E. A. Miller (N. Y. C. & St. L.), and other members, which brought out a clearer understanding of the requirements.

MINIMUM REQUIREMENTS FOR HEADLIGHTS

The committee has gotten together considerable information on this subject from railways and also a great deal of data concerning tests on various headlights made at Purdue University, and some tests of a number of headlights which were made at the United States Bureau of Standards. This data is rather conflicting, and the committee would ask to be continued for another year, hoping at that time to submit a full report to the convention. The request was granted.

REVISION OF STANDARDS

Commitee:—T. W. Demarest, J. D. Harris, H. T. Bentley.
[No report was presented by this committee.]

SAFETY VALVES

The report of this committee was received too late for approval and will be presented next year.

ADVISORY-TECHNICAL

Committee—G. W. Widen, chairman; A. W. Gibbs and W. A. Nettleton.

A progress report was made by the chairman, who stated that many subjects were under consideration and that a report would be made on them next year.

[Abstracts of reports and discussion on the following subjects will appear in the August issue: Smoke Preventing Devices for Firing Up Locomotives at Terminals; Flange Lubrication; Best Method of Treating Water; Best Construction of Locomotive Frames; Piston and Crossheads, and Steel Tires. —Ed.]

Railways of the World in 1909.—The *Archiv für Eisenbahnwesen* has issued its regular yearly railway statistical statement covering the railways of the world. Its latest figures are for the year 1909 and show the mileage of North America to be 277,015 miles, Europe 204,904 miles, Asia 61,800 miles, South America 42,329 miles, Africa 20,809 miles and Australia 18,849 miles. This indicates that more than one-half the total railway mileage of the world is found in North and South America, North America alone having over 10,000 miles more than Europe and Asia combined, notwithstanding the fact that the latter continents have 1,250 million inhabitants as against 115 million in North America.

An Alarm for Hot Bearings consists of a small tube and bulb containing mercury so arranged that rise of the mercury due to temperature closes an electric circuit and rings a bell. The apparatus is attached to the bearing in a box 2 in. square. When several bearings are connected an ordinary electric-bell indicator can be used to show which is becoming hot.

Master Car Builders' Association

FORTY-FIFTH ANNUAL CONVENTION.

ABSTRACTS OF THE REPORTS OF THE STANDING AND SPECIAL COMMITTEES AND OF THE DISCUSSION THEREON AS WELL AS THE ACTION TAKEN IN EACH CASE.

The president, T. H. Curtis, superintendent of motive power of the Louisville & Nashville Railway, opened the 45th annual meeting of the Master Car Builders' Association on Young's Million Dollar Pier at Atlantic City, June 19th, 1911. After prayer by the Rev. Dr. Caldwell, the president called upon William McWood, the oldest ex-president of the association, who presided in 1887 to 1890, to address the meeting.

Mr. McWood spoke briefly, following which the president delivered his address, forcibly drawing attention to the great importance of several subjects that were to come before the association at this meeting, as well as suggesting other features that should be considered in the near future. This address in part is given below.

Safety Appliances.—The past year has been a very eventful one in the history of this Association and we have before us for immediate consideration several very important subjects. The twenty-fourth annual report of the Interstate Commerce Commission contains a report of the chief inspector, J. W. Watson, in the summary of which it is shown that in the year ended June 30, 1910, nearly a half million freight cars were inspected and a little over 5 per cent. were found to be defective. When comparing these figures with those for the year ended June 30, 1905, in which about one-fourth of a million freight cars were inspected and over 22 per cent. were found to be defective, we have the comfort of knowing that an improvement was made, but there is still room for further effort. The comparative classified table of defective safety appliances on freight cars, for the year ended June 30, 1910, as to couplers and uncoupling devices, shows over 5,000 defective appliances. Over 1,500 of these defects were in the uncoupling chains. These could have been practically obviated by the use of a first-class chain that would not have cost over 15 cents. Over 2,000 more of the defects reported could have been righted within an average of one-half hour's time for each defect, and at a cost of not over 50 cents each. Over 6,000 cases of defects were reported in handholds, ladders and sill-steps. Of this number, over 600 were for missing sill-steps and nearly 4,000 for missing handholds. These omissions are to be deeply regretted. As to air brakes, over 16,000 cases were reported, of which over 6,000 were for brakes cut-out and over 2,000 for cylinder and triple valves not having been cleaned within the prescribed time. There were over 2,000 cases of release rods missing. These rods do not cost over 10 cents each.

Of the 16,000 defects cited, 10,000 of them could have been repaired by detaining the car from service only a half day at the most, and these repairs would have required only labor and they would not have required the services of large shops and machinery. The greater portion of the defects mentioned could have been obviated by greater care and supervision, and this supervision should have come from the higher officers. They should have known that the car men were properly instructed and drilled in regard to the importance of properly applying and maintaining safety appliances.

The matter of proper application and maintenance of safety appliances is of great importance. On July 1, 1911, the United States safety appliance standards as set forth in the order of the Interstate Commerce Commission of March, 1911, will become effective. While these standards may not be looked upon favorably by some, they are the result of many conferences and hard work by a committee of inspectors for the Interstate Commerce Commission and the general committee of railways on safety appliance standards, composed of members of our Association, the American Railway Association and others, and it is to be hoped that every effort will be put forth on the part of the members of this Association to familiarize themselves with these standards with a view to properly applying and maintaining them. And, furthermore, I urge you to co-operate with the Interstate Commerce Commission representatives, and by this co-operation the object of the law will be attained and uniformity will be the result, as well as good feeling between all concerned. One result of the enforcement of the safety appliance law will be the bringing into use of common standards for safety appliances for all classes of rolling stock equipment, regardless of the ownership of the equipment, whether it be a railway company or a private car line.

M. C. B. Standard Coupler.—A common standard in railway equipment, which is being interchanged, is a necessity—it is the need of to-day. To further profit by a common standard for equipment it is earnestly recommended that the Master Car Builders' Association speedily adopt a standard M. C. B. car coupler, and that this coupler must be standard in all of its parts, and every railway to use it only. The day of experimenting with car couplers is past, the state of the art has reached its maturity. A common standard for a car coupler will reduce the great number of repair parts that are now required to be kept in stock all over these United States for repairs to the great number of different styles of the M. C. B. car coupler, which is now a standard only in its contour lines. In brief, the M. C. B. coupler of to-day is standard in service, but interchangeable only as a whole, as the various makes are widely different in details of construction. To facilitate the prompt movement of traffic and also raise the standard of efficiency and reduce the cost of operation, a standard M. C. B. coupler is a very present need. This subject of a standard car coupler was earnestly recommended by one of my worthy predecessors in his address to our Association.

Car Wheels.—The day for small or light capacity freight train cars, as well as passenger equipment cars, is about past. So-called heavy or large capacity cars are now being built extensively, and some have been in operation for a long time. In some cases the strains and stresses are possibly exceeding the limits of safety for certain kinds of material that have been heretofore commonly used. As a citation I will mention car wheels. The steel car wheel is now considered by some large railway companies to be a necessity. I will not comment on the steel car wheel or on the different kinds or makes and their mission in railway equipment of to-day, but will say that the time is at hand when something should be done by this Association in prescribing and requiring that under all heavy capacity cars an efficient and suitable car wheel must be used. The common cast-iron car wheel of a grade used under light cars with good results needs to be materially increased in its strength and stability if it is to be used in service under heavy capacity cars of to-day.

Consolidation.—For several years the subject of the consolidation of the M. M. and M. C. B. Associations has been under consideration. Consolidation is a subject for each member to give sincere consideration, for it may materially affect him. In detail of subjects the two associations widely differ, and yet both locomotives and cars are used in the same train, and under the same management. One would not consider a detail knowledge of the car department as fitting him for detail service in the locomotive department, or vice versa. We now have two associations to deal with two departments, which are different in detail. In the American Railway Association the railways have the consolidation of these two departments; that is, the locomotive and the car department, and this association includes many other departments. The American Railway Association is the executive head of all associations like the Master Mechanics' Association, Master Car Builders' Association and others, and therefore, it may not be wise or necessary to effect a consolidation of the M. M. and M. C. B. Association, especially as one of the associations that would form a part of the consolidation is not executive, and the other is not executive except in a limited degree.

If these two associations are consolidated and possibly called American Railway Mechanical Association, as suggested, it will be composed largely of the men that are now members of these two associations. This would possibly be very satisfactory to the men occupying the higher positions in railway service, but there would probably soon be formed two other associations, one of the subordinate heads of the locomotive department, and the other the subordinate heads of the car department, and these two associations would take up separately in detail those subjects that are close to the trade in which they are earning their livelihood, the same as the master boiler makers and master blacksmiths now consider subjects in detail that are close to their trade. This subject of consolidation needs much care-

ful thought and consideration on your part, and all matters should be fully weighed before any definite action is taken.

ASSOCIATION BUSINESS

Secretary Taylor reported that there were now 422 active members, 361 representative members, 13 associate members and 19 life members, giving a total membership of 815. The number of cars reported in the association was 2,464,530, an increase of nearly 166,000 during the year. The treasurer's report showed a balance of $7.39 for the transactions of the year and a surplus fund amounting now to $1,126.20. The annual dues were fixed at $4 per vote.

The name of Prof. E. C. Schmidt, University of Illinois, was presented for associate membership, and J. W. Marden (B. & M.) and J. W. Flemming (C. & O.) were proposed for life membership.

Under the head of new business F. W. Brazier (N. Y. C.) spoke most strongly concerning the work of the committee appointed to represent the association before the Interstate Commerce Commission on the subject of safety appliances, moving that a vote of sincere thanks be extended to them for their laborious duties and the very pleasant way in which they represented the association and brought about good feeling between the government and the railways. This motion was carried unanimously by a rising vote. This committee consisted of T. H. Curtis, A. W. Gibbs, C. E. Fuller, C. A. Seley and J. F. Deems.

H. H. Vaughan (C. P. R.) requested that the association establish a standard or limit for the height of the running board on the standard dimension box car and moved that the matter be referred to the Committee on Standards.

During the discussion it was brought out that there was a standard height for the top of a brake shaft and a standard distance between running board and brake wheel, which practically made the standard height of the running board. This was finally disposed of by instructing the Committee on Standards to include this dimension in their report for the next year.

G. W. Wildin made a motion that the matter of cleaning of triple valves be referred to the Committee on interchange, with instructions to prescribe a minimum time after a valve had been cleaned when the owner should be required to pay for another cleaning. This subject was given considerable discussion, and it appeared that the trouble was due to improper cleaning at various points, and it was suggested that the name of the road doing the cleaning, as well as the date, be stenciled on the valve so that the source of the improper work could be determined. It was finally moved and carried that the subject of cleaning triple valves be referred to the committee on train brake and signal equipment, with instructions to report on the matters brought up during the discussion.

ELECTION OF OFFICERS

The following officers were elected: President, A. Stewart, Southern; first vice-president, D. F. Crawford, Pennsylvania; second vice-president, C. E. Fuller, Union Pacific; third vice-president, M. K. Barnum, Illinois Central; treasurer, J. S. Lentz, Lehigh Valley. Executive Committee—F. W. Brazier (N. Y. C. & H. R.), C. A. Schroyer (C. & N. W.) and A. Kearney (N. & W.).

SAFETY APPLIANCES

Committee:—Theo. H. Curtis, C. B. Young, Henry Bartlett, T. M. Ramsdell, M. K. Barnum, W. O. Thompson, A. LaMar.

The Committee on Safety Appliances has carefully considered this important subject in the limited amount of time that it has had since the issuance of the order of the Interstate Commerce Commission in the matter of United States Safety Appliance Standards, dated March 13, 1911, which is a modification of the original order issued October 13, 1910.

The United States Safety Appliance Standards prescribed in the Interstate Commerce Commission's order of March 13, 1911, must be applied to all equipment built on or after July 1, 1911.

As to applying the United States Safety Appliance Standards prescribed in the Interstate Commerce Commission's order of March 13, 1911, to equipment built prior to July 1, 1911, the order of the Commission prescribed the following:

"(a) Carriers are not required to change the brakes from right to left side of steel or steel-underframe cars with platform end sills, or to change the end ladders on such cars, except when such appliances are renewed, at which time they must be made to comply with the standards prescribed in said order of March 13, 1911.

"(b) Carriers are granted an extension of five years from July 1, 1911, to change the location of brakes on all cars other than those designated in paragraph (a) to comply with the standards prescribed in said order.

"(c) Carriers are granted an extension of five years from July 1, 1911, to comply with the standards prescribed in said order in respect of all brake specifications contained therein, other than those designated in paragraphs (a) and (b), on cars of all classes.

"(d) Carriers are not required to make changes to secure additional end-ladder clearance on cars that have 10 or more inches end-ladder clearance, within 30 inches of side of car, until car is shopped for work amounting to practically rebuilding body of car, at which time they must be made to comply with the standards prescribed in said order.

"(e) Carriers are granted an extension of five years from July 1, 1911, to change cars having less than 10 inches end-ladder clearance, within 30 inches of side of car, to comply with the standards prescribed in said order.

"(f) Carriers are granted an extension of five years from July 1, 1911, to change and apply all other appliances on freight-train cars to comply with the standards prescribed in said order, except that when a car is shopped for work amounting to practically rebuilding body of car, it must then be equipped according to the standards prescribed in said order in respect to handholds, running boards, ladders, sill steps and brake staffs: Provided, that the extension of time herein granted is not to be construed as relieving carriers from complying with the provisions of Section 4 of the Act of March 2, 1893, as amended April 1, 1896, and March 2, 1903.

"(g) Carriers are not required to change the location of handholds (except end handholds under end sills), ladders, sill steps, brake wheels and brake staffs on freight-train cars where the appliances are within 3 inches of the location, except that when cars undergo regular repairs they must be made to comply with the standards prescribed in said order.

"(h) Carriers are granted an extension of three years from July 1, 1911, to change passenger-train cars to comply with the standards prescribed in said order."

This order prescribes the following standards.*

The committee recommends that the Association's standards for safety appliances, Plates 19 to 19-P, be withdrawn and that the United States Safety Appliance Standards be substituted.

Plates 19-A to 19-P contain cuts showing the manner of application of safety appliances to the various types of cars and these plates also contain texts pertaining specifically to the car illustrated by the respective plate. These texts were a great help to car inspectors and others desiring to gain information quickly, and it is recommended by the committee that plates with texts of the United States Safety Appliance Standards to cover the various types of cars be submitted at the next convention.

(NOTE.—The drawings for Plates 19-A to 19-P are in the hands of the Interstate Commerce Commission, and it is expected that copies will be received in time to distribute at the convention.—*Secretary*.)

Your committee recommends that designating marks for cars equipped with the United States Safety Appliance Standards be adopted.

The Interstate Commerce Commission's order prescribes that all cars built on or after July 1, 1911, shall be equipped with the United States Safety Appliance Standards, whereas there are various exceptions in the case of equipment built prior to July 1, 1911, it will be necessary to have two designating marks that a car may readily show whether it comes under the rules for equipment built on or after July 1, 1911, or under the rules for equipment built prior to July 1, 1911.

The committee recommends the following designating mark for cars built on or after July 1, 1911:

UNITED STATES
SAFETY-APPLIANCES
STANDARD.

and for cars built prior to July 1, 1911—

UNITED STATES
SAFETY-APPLIANCES

These markings to be used on each side of car; letters to be

* [Copies may be obtained upon request to the Sec. Interstate Commerce Commission, Washington, D. C.—Ed.]

not less than two (2) inches in height, with one-half (½) inch bar or staff of letter; arranged as nearly as possible to the spacing and arrangement as shown above.

Discussion.—Considerable discussion was aroused by the necessity of stenciling the words "U. S. Safety Appliances, Standard," on the cars or attaching a plate to the same effect. It was suggested that this be abbreviated to "U. S. S. A." or that an insignia or seal be attached which would mean the same thing, and take up much less room. The motion to this effect, however, was defeated.

The matter of distinguishing between cars which were standard in all particulars and those which during the next five years will be allowed to be operated with certain alterations, aroused considerable discussion, the point being that cars which were allowed to run were standard within the meaning of the law. It was finally pointed out by Mr. Seley that at the end of five years, when it will be necessary for all cars to be entirely standard, it will be a very difficult matter to take out those which need changes unless they were designated in some particular way, and that it was an understanding with the U. S. inspectors that this distinction would be made.

The report of the committee was then adopted.

REVISION OF CODE OF TESTS

Committee:—A. J. Cota, Chairman; J. R. Alexander, F. H. Scheffer.

Condition of Tests.

Construction of Rack.—Triple valves will be tested on a rack representing the piping of a one-hundred (100) car train. All cocks, angles and connections will be as nearly as possible identical with those in train service. The rack shall conform to blueprint No. C-11379 (Rev. 3-9-09) in the hands of the committee, which gives the proper fittings, piping, cylinders, auxiliary reservoirs, main reservoirs, automatic brake valves, etc.

Reservoir Capacity.—The main reservoir capacity shall be approximately 57,000 cubic inches.

The capacity of each auxiliary reservoir shall be such as will, with a pressure of 70 pounds, produce 50 pounds pressure in its brake cylinder when fully equalized in service application with 8 inches piston travel.

Air Supply.—The air supply for the test rack shall be obtained from a locomotive type of air compressor having a capacity of from 80 to 120 cubic feet of free air per minute. The compressor to be controlled by a single top-pump governor adjusted to maintain 110 pounds main reservoir pressure.

Brake-pipe Pressure.—Tests will be made with a brake-pipe pressure of 70 pounds, except when otherwise specified.

Brake-pipe Leakage.—With brake-pipe and auxiliary reservoirs charged to 70 pounds, the section of branch pipe between the cut-out cocks and triple valves, also the triple valves, should be tested with soap suds and leakage eliminated.

Branch pipe cut-out cocks should then be closed and brake valve placed in lap position; brake-pipe leakage should then not exceed 2 pounds per minute.

Brake Cylinders.—Brake-cylinder packing leathers must be maintained in good condition and free from leakage.

Piston Travel.—All tests shall be made with 8-inch piston travel, except when otherwise specified.

Construction of Triple Valves.—Triples must be so constructed that they can be secured and operated on apparatus conforming to Diagram No. D-15611 (which shows triple valve end of auxiliary reservoir, branch-pipe union and location of bosses for retaining valve pipe, with detail dimensions of each as well as detail dimensions between these parts when in the relative position they would occupy if triple valve were in place.)

Gauges and Recording Instruments.—The auxiliary reservoirs, brake pipe and brake cylinder of the 1st, 25th, 50th, 75th and 100th brakes shall be fitted with test gauges. All gauges must be calibrated and maintained in good condition.

Brake No. 1 shall be fitted with two recording pressure gauges, one to be connected to the brake-pipe branch pipe, the other to the brake cylinder, and brake No. 100 shall be fitted with a test gauge connected to the brake cylinder.

The attachment of electric circuit closers, also the general arrangement of the electric circuit wiring, shall be as shown on Plates A and A-1 (showing construction used on plant at Purdue University.)

Repetition of Tests.—Tests shall be repeated three times under the same general condition, a record being taken of each test, also the average result of each three tests. The room temperature at the time of the tests shall be recorded, also humidity.

Triple-valve Essentials.—The essentials of a quick-action triple valve are: first, charging; second, service applicaton; third, graduation; fourth, release; 5th, quick action.

Individual Triple-Valve Tests.

No. 1.—Charging Tests.

Not less than three triples, selected at random, shall be tested, as follows:

With the triple valve cut out at the branch pipe cut-out cock; the auxiliary reservoir empty; and 90-pound brake-pipe pressure maintained, the triple valve should be cut in.

A. Under these conditions the auxiliary reservoir should be charged from 0 to 70 pounds in not more than 90 seconds nor less than 70 seconds.

B. When triple is in normal release position, the auxiliary reservoir should be charged from 0 to 70 lbs., in not more than 60 seconds and not less than 40 seconds.

No. 2.—Service Application Tests.

Section "A."—(To determine sensitiveness to Service Application.)

1. Three valves, selected at random, shall be taken for this test and each tried separately. They will be tested on the first brake of the rack using the brake pipe only of the first car and locomotive, having the engine and tender brakes cut out.

2. These triple valves should apply in service when the brake-pipe pressure is reduced by direct discharge to the atmosphere through an orifice which will reduce brake-pipe pressure from 70 to 60 pounds, in 16 to 18 seconds, with brake valve and triple valves on locomotive and first brake cut out.

3. In preparing for this test, insert the required disk in union shown on Plate B with all cocks closed, after which open cock C and start test by opening cock B.

Section "B."—(Graduating Test.)

1. Three valves, selected at random, shall be taken for this test and each tried separately. They will be tested on the first brake of the rack, using the brake pipe only of the first car and locomotive having the engine and tender brakes cut out.

2. The first admission to the cylinder should be made with a reduction of brake-pipe pressure not exceeding 5 pounds; each

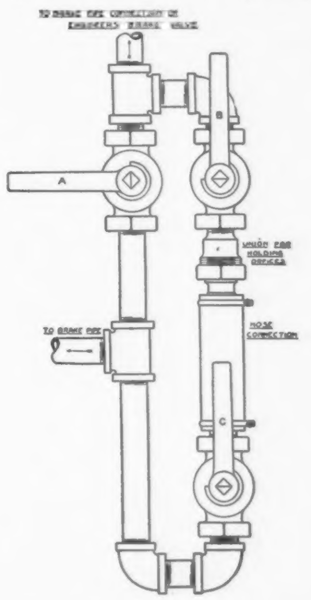


Plate B.

succeeding reduction should reduce the pressure in the auxiliary reservoir not to exceed three pounds, until equalization takes place. The pressure in the brake pipe should not be more than 3 pounds lower than the equalized pressure in the brake cylinder and reservoir at equalization.

Section "C."—(Holding Test.)

Three valves selected at random will be taken for this test and each tried separately on the first brake on the rack, using the brake pipe only of the locomotive and the first car, having the triple valves cut out on engine and tender. The one brake will be applied, admitting as nearly as may be 15 pounds into the brake cylinder following a service applicaton. Record of pressures in the auxiliary reservoir cylinder and brake pipe will be taken as follows:

First. At completion of application.
Second. In five minutes.
Third. In ten minutes.
Fourth. In fifteen minutes.

In this test, when a constant brake-pipe pressure is maintained, the brake-cylinder pressure must not be increased more than 5 pounds in 5 minutes.

Section "D."—(Release test.)

Three triple valves, selected at random, shall be taken for

this test and each tried separately. They will be tried on the first brake of the rack using the brake pipe only of the first car and locomotive having the engine and tender brakes cut out. When the triple goes to normal release position it must exhaust the air from the brake cylinder from 50 to 0 pounds in not more than 15 seconds.

When the triple goes to retarded release position it must exhaust the air from the brake cylinder from 50 pounds to 0 pounds in not more than 40 seconds.

NO. 3.—EMERGENCY APPLICATION TESTS.

(To determine sensitiveness to quick action.)

Three triple valves, selected at random, shall be taken for this test and tried separately on the first brake of the rack. During this test the locomotive and tender triples are to be cut out.

Section "A."—These triple valves must give a quick-action application when the brake-pipe pressure is reduced by direct discharge to the atmosphere through disk with a 14/64-inch orifice.

Section "B."—These triple valves must not give a quick-action application when the brake-pipe pressure is reduced by direct discharge to the atmosphere through a disk with a 10/64-inch orifice.

Section "C."—(Holding Test.) Three triple valves, selected at random, shall be taken for this test and tried separately on the first brake on the rack.

The brake will be applied in quick action by moving the brake-valve handle to emergency position where it must remain until completion of test for the purpose of insuring the discharge of all brake-pipe pressure. Record of pressure in auxiliary reservoir and brake cylinder will be taken as follows:

First.—At completion of application.
Second.—In five minutes.
Third.—In ten minutes.
Fourth.—In fifteen minutes.

In this test, the auxiliary reservoir and brake-cylinder pressure must not show a reduction of more than 5 pounds in 5 minutes.

RACK TESTS.

NO. 4.—SERVICE APPLICATION TESTS.

Section "A."—(Service Equalization.)

With a service reduction of 25 pounds from brake-pipe pressure, a brake-cylinder pressure of not less than 48 pounds, nor more than 52 pounds, must be obtained.

Section "B."—(Graduating Test.)

1. A reduction of 5 pounds in brake-pipe pressure should apply lightly the 100 brakes. However, the brake-cylinder pressure may not be sufficient to show on all test gauges.

2. A further reduction of 4 pounds to 6 pounds should increase the cylinder pressure of all brakes.

3. A further reduction, making a total of 25 pounds, should equalize the pressure between the auxiliary reservoirs and brake cylinders.

Section "C."—(Service application time.)

Brakes will be applied by reducing brake-pipe pressure 10 pounds.

There shall not be more than 25 seconds difference in the time of obtaining 10 pounds pressure in the cylinders of the 1st and 100th brakes.

NO. 5.—EMERGENCY APPLICATION TESTS.

Section "A."—(Quick action, time and pressure.)

The 100th brake must be applied with at least 45 pounds pressure in 6¼ seconds from the movement of the brake-valve handle to emergency position and at least 55 pounds in 7 seconds. The final maximum pressure in this test must not be less than 15 per cent. nor more than 20 per cent. above the pressure given by the same brake in full service application.

This test will also be made to determine that quick action is obtained with:

First.—Four inches piston travel.
Second.—Twelve inches piston travel.

(NOTE.—The object of this test is to secure, as nearly as possible, uniformty of pressures in brake cylinders in an emergency application and uniformity of time required to obtain the pressures; to secure a minimum length of stop and a minimum of shock and of trains parting.)

Section "B."—(To determine whether quick action will follow a service application.)

Using the 100 brakes, make a service reduction such as will give 20 pounds cylinder pressure on the first brake. Then place the brake-valve handle in emergency position, which should cause quick action operation of all triple valves.

The pressure in the first cylinder will be increased or decreased by steps of about 5 pounds until the point at which quick action commences or ceases is determined.

Section "C."—(Quick-action jumping test.)

With brakes Nos. 1, 2 and 3 cut out, quick action should be obtained with the remainder of the brakes by an emergency reduction, and the time, from the movement of the brake-valve handle to emergency position to obtain 45 and 55 pounds cylinder pressure on the 100th brake, should not be increased more than one second over that required to obtain the same pressure with all brakes cut in.

This test should be repeated with groups of three brakes cut out, consisting of Nos. 2-3-4, 3-4-5, 4-5-6 and 5-6-7, and the time from the movement of the brake-valve handle to emergency position to obtain 45 and 55 pounds cylinder pressure in the 100th brake should be the same as with all brakes cut in.

These tests will also be made with piston travel of 4 inches.

NO. 6.—HOLDING TESTS.

Section "A."—(Following a service application.)

The one hundred brakes will be applied, admitting, as nearly as may be, 15 pounds into the cylinder of the first brake. Record of pressures in the auxiliary reservoirs and cylinders will be taken at all record points as follows:

First.—At completion of application.
Second.—In five minutes.
Third.—In ten minutes.
Fourth.—In fifteen minutes.

In this test any increase of brake-cylinder pressure should be in proportion to the reduction in brake-pipe pressure due to leakage.

Section "B."—(Following a quick-action application.)

The 100 brakes will be applied in quick action by placing the brake-valve handle in emergency position, where it will be left until completion of test, for the purpose of insuring the discharge of all brake-pipe pressure. Record of pressures in auxiliary reservoirs and cylinders will be taken at all record points as follows:

First.—At completion of application.
Second.—In five minutes.
Third.—In ten minutes.
Fourth.—In fifteen minutes.

The results of this test must not indicate an excessive amount of back leakage into brake pipe.

NO. 7.—RELEASE TESTS.

Section "A."—(Release Time.)

The 100 brakes shall be applied with an 18-pound service reduction of brake-pipe pressure and brake valve then placed in release position. Time will be taken from the movement of the brake valve into release position until pressure is reduced to 5 pounds in the cylinder of the first brake.

The pressure in the cylinder of the first brake should not reduce to 5 pounds in less than 18 seconds nor more than 25 seconds.

(NOTE.—Main reservoir pressure must be 110 pounds at time of release.)

Discussion.—E. W. Pratt (C. & N. W.) asked for information concerning the reason for using the reduction in brake pipe pressure under the service application test, while in emergency application a certain sized orifice was used to obtain the proper reduction. It was explained by the committee that because of the effect of the movement of the air in emergency application being almost instantaneous that it would be practically impossible to specify a time limit. Mr. Pratt also asked to have the type of brake valve specified, so that it might be standard on the testing rack. It was explained by the committee that any type of brake valve could be used.

The report was accepted and the recommendations submitted to letter ballot.

COUPLER AND DRAFT EQUIPMENT

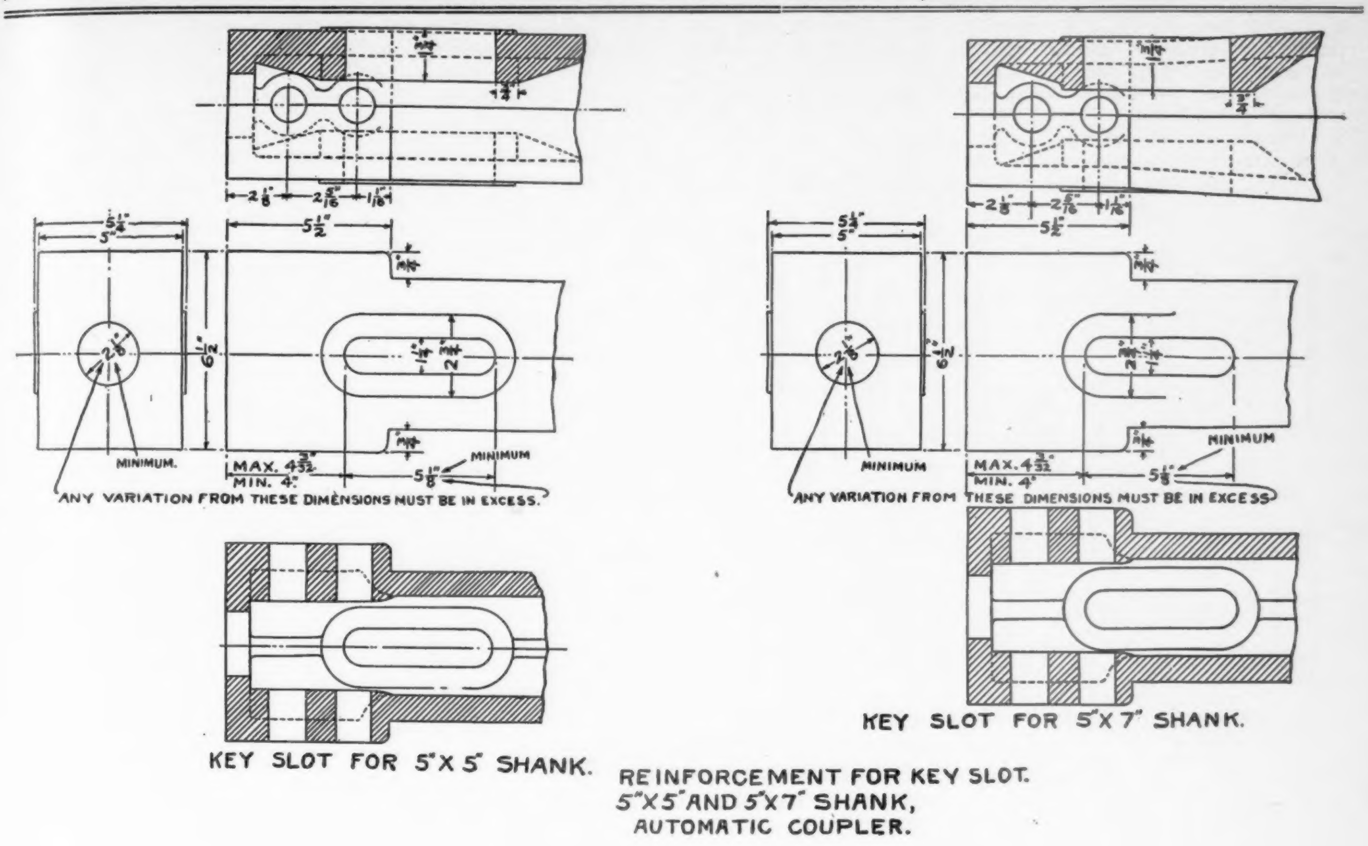
Committee:—R. N. Durborow, Chairman; G. W. Wildin, F. W. Brazier, F. F. Gaines, F. H. Stark, H. LaRue, H. L. Trimyer.

END-LADDER CLEARANCE.

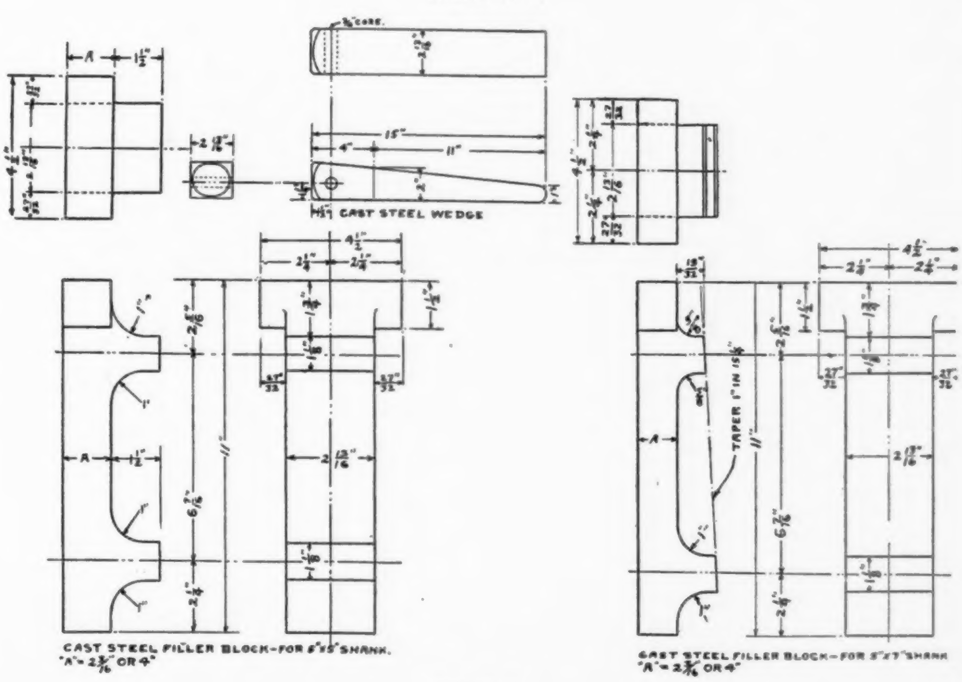
Numerous inquiries were received from the members, relative to the question of redesigning the M. C. B. Standard coupler to provide the necessary end-ladder clearance on existing freight-equipment cars to comply with the United States Safety Appliance Standards. The committee has considered this questoin in its different phases and calls attention to the fact that the Association is confronted with a serious problem in the resultant effects, both to the railroad companies and the manufacturers, unless a proper solution of the matter is made at this convention.

It is believed that the most satisfactory way of meeting the conditions imposed is to adopt one, or not more than two, temporary standard automatic couplers, so as to provide for the necessary end clearance as affecting present freight-equipment cars.

This proposed new coupler could be designed by lengthening the shank or by increasing the length of the head between the coupler horn and pulling face of knuckle; either of which would probably introduce conditions contributory to bending of shanks



SHEET A.



SHEET B.

and breaking or buckling of center and end sills, due to the increased length of lever arm. The idea of gaining the required space by lengthening the shank should be discouraged, as it involves changes in the end construction of the car and a greater liability of bent coupler shanks, and your committee believes that the clearance required should be gained by changing the present standard distance between inside face of knuckle and striking horn of coupler.

It is desired that in thus providing for what may be termed an emergency condition that the Coupler and Draft Committee by no means intends to deviate from any fruitful results obtained by the Association in the past years, but rather to permit the introduction of this proposed coupler to meet what is nothing more than a temporary need. It should be kept clearly in mind that this emergency coupler is not to be placed on any new equipment, but is merely an expedient to meet a required condition. This change in coupler head would increase the number of M. C. B. Standard couplers. In order that the number of standards may be kept to a minimum, the members should advise your committee promptly the amount of increase in length of coupler necessary and the number of cars requiring this increase. When these replies are received it will enable the committee to decide whether it will be necesary to care for more than one additional temporary coupler. It should be borne in mind that it will be necessary to carry these emergency couplers in stock at all repair points, so as to maintain the proper end clearance when making repairs.

SUMMARY.

A summary of the recommendations which the committee offers to be submitted to letter ballot, to be adopted either as Standards or Recommended Practice, is as follows:

STANDARDS.

1. That the key-slot reinforcement for the 5 by 5 inch coupler be made 1¾ inches in thickness, as shown on Sheet A, and that the V-shaped reinforcement on both the 5 by 5 inch and 5 by 7 inch coupler be changed in design, as shown on Sheet A.

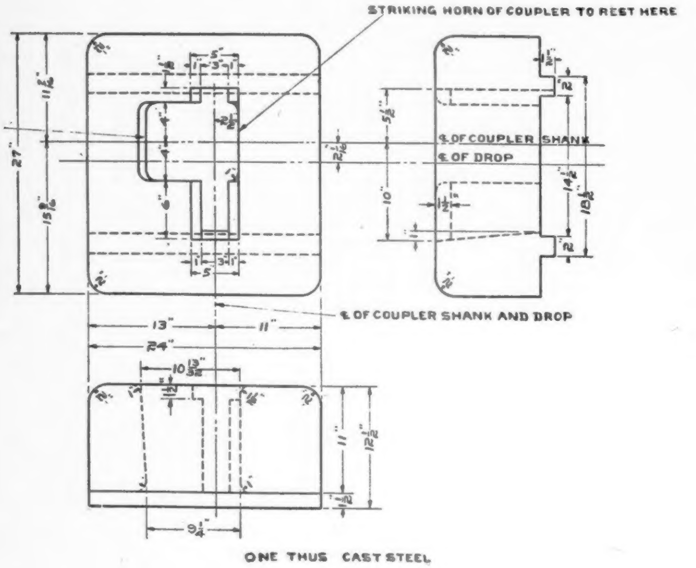
SPECIFICATIONS FOR M. C. B. AUTOMATIC COUPLER.

2. That the specification for M. C. B. automatic couplers, as

given on page 728, 1910 Proceedings, have the following sentence added after the words "Must not be painted," in the fourth sentence from top of page, "The word couplers as here used includes the bar itself and the contained parts within the head, such as locks, knuckle throws, etc."

3. That knuckle pins must bear a manufacturer's mark on head of pin.

4. That dimensions and bottom of coupler shank, Sheet 23,



SHEET C.

reading "12 inches, no projection here," be increased ½ inch forward toward head of coupler.

RECOMMENDED PRACTICE.

1. That the use of set-screws, shown on Sheet J, 1909 Coupler Report, for holding the coupler in place when making drop test, be abolished; that filler blocks and wedges, shown on Sheets B and E, be used instead of the set-screws, and that the base block, shown on Sheet I, 1909 Coupler Report, be changed to conform to that shown on Sheet C.

Discussion.—What afterwards proved to be practically universal sentiment was expressed by F. W. Brazier (N. Y. C.), who spoke strongly in favor of the designing of a standard coupler, speaking in part as follows:

In the convention of 1904 I suggested that a committee be formed to report the desirability of having a coupler designed standard so that the knuckle locks and other parts of the coupler would all be interchangeable. The coupler committee of 1905 recommended that a special committee be appointed to work in connection with the coupler committee. In the convention of 1906, the committee on the composite design of coupler, of which I was a member, made its report and great stress was then laid on the fact that none of the manufacturers were willing to give up their patent rights and surrender them to the association; also it was the opinion of the railway representatives of the committee that it was not in accordance with business ethics to ask the manufacturers to surrender their rights without compensation and the Master Car Builders' Association is not a body which can properly acquire rights of this character and sell them or give them to manufacturers, without rendering itself liabe to charges of unfair discrimination.

"It was also agreed by the committee that if we only had three or four kinds of couplers there would be less cause for complaint than at the present time. This committee concluded its report by commending that no couplers be purchased by railway companies unless they meet with the requirements of the M. C. B. Association and recommendations of the standard committee on tests of M. C. B. couplers and in this way the elimination of all couplers which do not fulfil the requirements would soon be effected. I am quoting the above to show the feeling at that time. I feel the time is come, and the experience that we have had with couplers is sufficient, so that we should get down to one standard design of couplers. My reasons are as follows:

"We have to carry so many different parts of couplers in stock to maintain the different kinds that it is great expense to the companies, a serious delay to freight and on a loaded car marked out for broken knuckle or knuckle lock of a coupler not standard to the line on which the failure occurs it is necessary, in order to make repairs, to remove the entire coupler and apply a new one complete. This means the application of a coupler not standard to the car. I find that the road I represent has in the past few months been compelled to order a little over 10,000 knuckles of 39 different makes; about 7,000 knuckle locks of 21 different makes; 246 knuckle lifters of different makes, and so on with other minor parts of couplers.

"In these days of economy when we are trying to keep our stock low, you can readily see what it means to have so many different kinds of couplers to maintain. Recently we had a statement made showing the number of second-hand freight couplers on hand that we were holding for repair to be a total of 2,015; 1,547 we were holding for knuckles; 1,435 of the 2,015 for locks, and the balance for other minor parts. This represented 26 different makes of couplers. From my viewpoint this is all uncalled for—the railway companies represented in the association could have a special committee, or the coupler committee meet with the coupler manufacturers, and, without doubt, a design of coupler could be agreed upon that would meet all the requirements. I feel positive about this point, as I have taken it up with several of the prominent coupler manufacturers, and I am assured that they would be willing to get together and settle this point.

"The second plan would be to have the coupler committee given power to design a coupler that meets the requirements, and that the association pay the necessary expense; then we would have a coupler with a knuckle that would be interchangeable for all couplers, and reduce the cost of our stock many thousand dollars a year, and also would save the delay of trains. A coupler arrangement should be provided at the same time, that would be operative either at the side or bottom and stop the trouble we are having with the top uncoupling arrangement. After 15 years of experience we know that either bottom or side uncoupling arrangement can be made absolutely satisfactory.

"At the present time, when one of these numerous couplers, which are not standard to our own lines breaks, we either have to set the car off, or possibly in some cases use an emergency knuckle, and under the Safety Appliance Law no two cars could be coupled together with them; neither could we interchange this car with a foreign line with an emergency knuckle in, simply because we have not a knuckle that would fit the coupler. Now, what is the result? This car goes to the repair track. The coupler is taken out. A coupler is put in that we have in stock. Then, rather than to throw away the foreign coupler, which was removed, we order a knuckle and hold the coupler body until we get the knuckle, which may be any time from 1 to 4 months. These are facts, and occurrences of this kind are happening every day on our roads. It is time that this association should wake up and take some action. I could give a great deal more data on this subject. I have the facts and figures with me showing the expense this means to the railways throughout the country as well as those I am representing.

"I wish to repeat what I have said before, that there is no reason why this one design of coupler cannot be brought about and be interchangeable the same as journal bearings, oil boxes and other parts of cars. I am told that it will stop competition. It may be very interesting to the members of this association to know that to-day there is no competition in couplers. The coupler manufacturers have apparently devised means whereby the couplers are all one price, so the argument of competition is the same in either event. I believe that we should give this subject more attention and more discussion than ever before in view of the alleged inefficiency of railway methods to which so much publicity has been given. I believe that a duty rests directly on this association now, and I certainly believe that this can be brought about at the present time better than at any time in the past."

J. F. Deems (N. Y. C.) emphasized what Mr. Brazier had said, and urged early action on the question.

Other members speaking in favor of the standard coupler were J. J. Hennessey (C. M. & St. P.), J. F. Walsh (C. & O.), C. E. Fuller (U. P.), and H. L. Trimyer (S. A. L.). C. A. Schroyer (N. & W.) believed that the knuckle, at least, should be made standard, while the details of the locking arrangement were not so necessary.

It was moved by G. W. Wildin (N. Y., N. H. & H.), and seconded by William Garstang (Big Four), that the committee on coupler and draft equipment be instructed to design a M. C. B. coupler and authorized to take the matter up with the coupler manufacturers and invite them to join the committee in designing and adoping a standard freight car coupler. This motion was discussed at some length with little opposition and was adopted.

M. K. Barnum (Illinois Central) made a motion that the committee be authorized to incur such expense for employment of a mechanical engineer, or other assistance, that might seem justifiable. This motion was carried.

A motion by Mr. Gaines (C of G.) to the effect that couplers with 11¼ in. length be submitted to letter ballot, was actively

discussed and, apparently largely on the basis of a new standard coupler to be presented next year and the objection to having a temporary standard in existence, the motion was lost.

It was then moved and carried that the recommendations of the committee be submitted to letter ballot.

The immediate need of a temporary coupler was again forcibly brought to the attention of the meeting by Mr. Seley and a motion was made by him that the committee be instructed to prepare a design and submit it to the executive committee with as much speed as possible, was carried. It is the intention of the executive committee to submit this to letter ballot before the next convenion.

REVISION OF STANDARDS AND RECOMMENDED PRACTICE

Committee:—R. L. Kleine, Chairman; W. E. Dunham, T. H. Goodnow, W. H. V. Rosing, C. E. Fuller, O. C. Cromwell, T. M. Ramsell.

STANDARDS.

JOURNAL BOXES AND DETAILS FOR JOURNALS 5½ BY 10 INCHES.

The committee concurs in the following recommendations, and suggests that they be referred to letter ballot.

Journal boxes for the heavier capacity equipment are being made of pressed and cast steel, and in order that the standards may be up to date, the following changes in the notes on Sheet 11 are recommended:

Section of box may be made either circular or square below the center line and material may be cast iron, malleable iron, pressed steel or cast steel; provided all the essential dimensions are adhered to.

When journal box is made of material other than cast iron, reduction in thickness of metal and coring to lighten weight is permissible, provided all the essential dimensions which affect interchangeability and the proper fitting of contained parts are adhered to.

If the method of manufacture does not permit of placing the letters "M. C. B." on the side of the journal box they may be placed on the top between the hinge lug and seat of truck sides.

JOURNAL BEARING WEDGE FOR JOURNALS 5½ BY 10 INCHES.

With reference to the manufacture of forged journal-box wedges, it is the opinion of the committee that this is a question for the railroads using these wedges to see that they are provided with wedges of the proper dimensions and shape regardless of whether they be forged steel or malleable iron. There is no evidence submitted that these wedges do embed themselves in the journal boxes, and it does not seem that the Association can govern the manufacture of the wedges any more than prescribing the proper Standard.

AXLES.

The committee is not in favor of having more than one limit for the minimum diameter to which the journal and wheel seat may be worn as this would lead to too much confusion in the shops. It is thought that without increasing the present number of axles and without changing the minimum diameters of journal and wheel seat, the present table of capacity markings for cars could be so amended as to permit variations in the capacity markings of the cars (minimum variations 5,000 or 10,000 pounds) by adding to the table the maximum load for which the representative axles were designed, and by deducting from this maximum load the light weight of the car and the overload of ten per cent., which would give the correct capacity to be stenciled on the cars. For the consideration of the members before any definite action is taken.

LIMIT GAUGES FOR INSPECTING SECOND-HAND WHEELS FOR REMOUNTING.

The committee recommends:

A. That the note under limit gauge shown on Sheet M. C. B. 16-A be changed to read: "For remounting cast-iron wheels cast prior to the M. C. B. standard tread and flange adopted in 1909.

B. That drawings be added showing the limit gauge for cast-iron wheels with M. C. B. tread and flange adopted in 1909, reducing the limit for height of flange from 1 5/16 inches to 1 3/16 inches, and a note added under these gauges reading as follows: "For remounting cast-iron wheels with M. C. B. standard tread and flange adopted in 1909."

AIR BRAKES—GENERAL ARRANGEMENT AND DETAILS.

The committee approves the suggestion of a member that to conform to U. S. Safety Appliance Standards the paragraph referring to hand-brake chain should be changed to read: "Brake chain shall be of not less than ⅜-inch, preferably 7/16-inch, wrought iron or steel, with a link on the brake-rod end of not less than 7/16-inch, preferably ½-inch, wrought iron or steel, and shall be secured to brake-shaft drum by not less than ½-inch hexagon or square-head bolt. Nut on said bolt shall be secured by riveting end of bolt over nut.

AIR BRAKES—GENERAL ARRANGEMENTS AND DETAILS.

The committee believes that cast steel of proper section is suitable for truck-lever connection and would suggest that a note be added to Sheet M. C. B. 18 reading as follows: "Cast steel may be used for truck-lever connection if of equal strength to the section of wrought iron or steel specified."

LABEL FOR AIR-BRAKE HOSE.

The committee recommends that the label and text (paragraph 7, page 709) referring to same be omitted from the specifications for air-brake hose and placed under the label for air-brake hose, paragraph 7, to be changed to read as follows: "Each length of hose must have vulcanized to it the label for air-brake hose of white or red rubber as shown under the specifications, Label for Air-brake Hose. Each lot of 200 or less must bear the manufacturer's serial number commencing at one on the first of the year, and continuing consecutively until the end of the year. For each lot of 200, one extra hose must be furnished free of cost.

Change second paragraph on page 711 under the heading of "Specifications and Tests for Woven and Combination Woven and Wrapped Air Brake Hose," to read: "Each length of hose must have vulcanized to it the label for air-brake hose of white or red rubber as shown under the specifications 'Label for Air-brake Hose.'"

Change second paragraph under the heading "Label for Air-brake Hose," page 712, to read: "Each length of hose must have vulcanized to it a standard air-broke hose label of white or red rubber as shown. The following information must be branded on the label: On the top of the badge the initials or name of road or purchaser and the size 1⅜ inches; on the bottom the name of manufacturer; on the left-hand end the month and year of manufacture; on the right-hand end the serial number and the letters M. C. B. Standard; and in the center field the years, letters A and R, and the numerals for the month to show the date of application and removal. These letters and figures must be clear and distinct, not less than ¼-inch in height, excepting name of manufacturer, which must not be less than ⅛-inch in height, and stand in relief not less than 1/32-inch. Letters and figures covering the application and removal of the hose must be so applied that they can be removed by cutting without endangering the cover."

LABEL FOR AIR-BRAKE HOSE.

Dimensions of label to be 4 by 2½ inches. Extensions may be made on right-hand end.

The label shown on Sheet M. C. B. 18 to be omitted from this sheet and included on a new Sheet 18-A full size.

No change has been made in the air-brake hose label aside from increasing the size of letters and numerals from 3/16-inch to ¼-inch in height, and name of manufacturer, which has been specified to be not less than ⅛-inch in height. The text has been revised to correspond with label.

The committee concurs in the suggestion of a member that we should add a paragraph to the specifications, Label for Air-brake Hose, page 713, to cover fitting up hose to the couplings and nipples so that the label on the hose will show toward the side of the car in such a position that the car inspectors can readily read the label from the side of the car. This matter should be referred to letter ballot for adoption as Recommended Practice, and, if approved, proper reference should be made in the text and included under Sheet M. C. B.—Q.

SAFETY APPLIANCES.

Pages 715 to 722, Sheets M. C. B. 19 to 19-B.

The committee approves the suggestion to adopt the Recommended Practice for brake details shown on Interstate Commerce Commission Plate "A" as follows: "Brake wheels both flat and dished 15 inches and 16 inches diameter, brake ratchet wheel, brake ratchet-wheel pawl and brake ratchet-wheel pawl plates." Also that the text and sheets be revised to conform to Interstate Commerce Commission requirements.

HEIGHT OF COUPLERS.

Committee suggests that the text be modified to conform to the order of the Interstate Commerce Commission dated October 10, 1910, reading as follows: "The maximum height of drawbars for freight cars measured perpendicularly from the level of top of rails to the centers of drawbars for standard-gauge railroads shall be 34½ inches, and the minimum height of drawbars for freight cars on such standard-gauge railroads measured in the same manner shall be 31½ inches, and on narrow-gauge railroads the maximum height of drawbars for freight cars measured from the level of tops of rails to the centers of drawbars shall be 26 inches, and the minimum height of drawbars for freight cars on such narrow-gauge railroads measured in the same manner shall be 23 inches, and on 2-foot gauge railroads the maximum height of drawbars for freight cars measured from the level of the tops of rails to the centers of drawbars shall be 17½ inches, and the minimum height of drawbars for freight cars on such 2-foot gauge railroads measured in the same manner shall be 14½ inches.

RECOMMENDED PRACTICE.

JOURNAL BOX AND PEDESTAL FOR PASSENGER CARS FOR JOURNALS 5 BY 9 INCHES.

The committee recommends the following:

(a) Sheet A, 5 by 9-inch passenger journal box, change mouth of box and dust-guard opening to conform to freight box and advance to Standard.

(b) Pedestal for 5 by 9 journal box shown on Sheet B advance to Standard.

CAST-IRON WHEELS.

The committee believes that the specifications for cast-iron wheels should be advanced to Standard, but before doing so should be referred to the Wheel Committee for any changes or corrections that may be necessary.

AIR-BRAKE APPLIANCES.

The committee concurs in the recommendation that the steam and air line connections for passenger cars be advanced to Standard.

The committee recommends that the three sheets M. C. B.—J, K and L, be referred to the Committee on Train Brake and Signal Equipment for revision to conform to the U. S. Safety Appliance Standards adopted March 13, 1911, which provide that the hand-brake shall operate in harmony with the power brake.

STEAM AND AIR LINE CONNECTIONS.

The committee concurs in the recommendation that air-brake hose must be 1⅜ inches inside diameter, but does not approve the 1⅛-inch diameter for air-signal hose. It also recommends that the heading on page 775 be changed to read: "Steam and Air Connections for Passenger Cars."

The committee recommends that the angle cock shown on Sheet Q be changed to show 30 degrees from the vertical.

UNCOUPLING ARRANGEMENTS FOR M. C. B. COUPLERS.

The committee recommends to advance to Standard the clevises, links and pin now shown on Sheet C, and to include Plate B and text governing the uncoupling levers of the U. S. Safety Appliance Standards, adopted by order of the Commission dated March 13, 1911, in the standards of the Association.

COUPLER YOKES.

The committee concurs in the recommendation that the yoke for the twin spring gear, yoke for tandem spring gear and yoke for friction gear be advanced to standard, and suggests that they be shown on a new Sheet No. 23-A.

DROP-TEST MACHINE.

The committee concurs in the recommendation that the drop-test machine for M. C. B. couplers and knuckle pins be advanced to standard.

SIGNAL-LAMP BRACKETS AND SOCKETS.

The committee suggests that the slotted and tapered dimensions be shown, the other details of the bracket omitted, and advanced to Standard.

BRAKE CHAINS.

The committee concurs in the recommendation to advance brake chains shown on Sheet M. C. B. 18 to Standard.

BOX-CAR OUTSIDE-HUNG SIDE-DOOR FIXTURES.

The committee approves the suggestion that door-hasp staple, shown on Sheet M. C. B.—F, be increased in length from 5⅜ inches to 16 inches, to provide for four bolts, for fastening staple to door. The present hasp staple is causing trouble, due to pulling through the wood on account of insecure fastening.

STANDARD LOCATION FOR CAR-DOOR SEALS.

At a special meeting of the General Managers' Association of the Southeast, held on September 9, 1910, the following resolution was unanimously passed:

"*Resolved*, That it be the sense of this meeting that car-door fastenings should be located 5 feet above top of rail and 1 foot above the floors of the cars, and it is recommended to all lines that they include these specifications for all new equipment, and that it be made a rule to alter the location of door fastenings for all cars going through the shops for general overhauling to conform to this standard."

It was further stated that this action will be communicated to the Master Car Builders' Association, the various General Managers' Associations and to the American Railway Association, the cause for this action being the present difficulty in procuring proper seal records, by reason of the seals on most cars being so high from the ground that those entrusted with the duty of procuring the sealing records cannot read them.

The committee has given this matter very careful consideration, and would call the attention of the members to Sheet M. C. B.—F, Box Car Outside Hung Side Door, on which the hasp to which the seal is attached is located "about 5 feet 6 inches from the top of rail," and to Sheet M. C. B.—F-1, Box Car Flush Side Door, on which the hasp to which the seal is attached is located "5 feet 6 inches from top of rail." Flush doors of the description shown on Sheet F-1 are sealed both at door-rod handle and at the hasp, therefore, the sealing dimension should be shown at the door-rod handle as well as at the hasp. On some refrigerator cars, on account of the double-door bar-lock construction, it is difficult to bring the sealing eye lower than 5 feet 8 inches above the top of rail, and on box cars equipped with vertical door rods sufficient clearance must be allowed between the top of station platform and the handle of the door rod for proper manipulation of the door-rod handle.

It is unquestionable that the seal should be located on the doors within reasonable reading distance from the ground in order to facilitate application and inspection of the seals, and the committee would recommend the following: Center of hasp or sealing eye should be located not less than 5 feet above top of rail nor more than 5 feet 9 inches above top of rail. These dimensions to be shown on Sheets F and F-1 and proper reference made in the text.

MARKING OF FREIGHT EQUIPMENT CARS.

The suggestion to add the station symbol where car is weighed is approved.

STENCILING CARS.

The committee suggests that the word "stenciling" in index and text be changed to "lettering," to conform to the wording on Sheet M.

LIMIT GAUGES FOR ROUND IRON.

The Executive Committee referred to the Committee on Revision of Standards and Recommended Practice, the following: To investigate and report on whether any changes are necessary in the present Recommended Practice covering the diameters of round iron.

At the present time the Recommended Practice does not show any limits for sizes of round iron more than 1⅝ inches in diameter; furthermore, a manufacturer has asked that the limits be increased for bars 1⅜ inches and over in diameter, claiming that the present limits are rather close for rolling-mill practice, and can only be met under special conditions and with special care, which means a special price.

The committee, after carefully considering this question, believes it will be entirely proper to adopt the Standards of the Master Mechanics' Association for the allowable variations, both below and above the nominal size for round iron 1½ inches and more in diameter. Revised table is given below:

Nominal Diameter of Iron, Inches.	Large Size Inches. End.	Small Size Inches. End.	Total Variation. Inches
1½	1.5115	1.4885	.023
1⅝	1.6370	1.6130	.024
1¾	1.7625	1.7375	.025
1⅞	1.8880	1.8620	.026

Round iron 2 inches in diameter and over should be rolled to nominal diameter.

SPLICING OF STEEL CENTER SILLS.

SPLICING OF WOODEN SILLS.

The committee recommends:

(a) To advance text on pages 782 and 783 on splicing of sills, steel and wooden, to Standard, and omit reference in the text to draft sills, as the latter are misconstrued in some quarters to mean draft timbers.

(b) Advance Sheet D to Standard, and add a note under Fig. 9-B, reading, "Center sills," and a new Fig. 9-C, reading, "Intermediate and side sills."

(c) Change Fig. 9-B to Fig. E, and change Fig. 9-C to Fig. F.

Discussion.—There was objection raised to the recommendation to omit from the volume of proceedings the code of interchange laws. This matter was finally decided by the passing of a motion made by Mr. Seley that the code of interchange rules and the rules for loading long material be incorporated in the proceedings, while the arbitration committee's proceedings should be eliminated.

The matter of the height of hasp or seal pin on doors was given considerable discussion, and it was finally decided to make this recommendation read that the height should be at 5 ft. with allowance variation, instead of between 5 ft. and 5 ft. 9 in. as recommended by the committee. This change was accepted by the committee and a motion to refer the report, as thus amended to letter ballot was carried.

Among the matters in the committee's report which were to be brought before the convention for decision the subject of the marked carrying capacity of cars being raised in proportion as the dead weight of the car was reduced, i. e., that the total weight of car and load should remain constant, was given an active discussion. There was considerable objection raised to the matter of marking up car capacities by means of a paint brush, while other members believed that any saving in the dead weight of the car which they were able to make by design should be added to the revenue capacity of the car. It was pointed out by M. K. Barnum (I. C.) that there were many features concerned with this subject and he made a motion that the matter be referred to a special committee for a report next year. This motion was seconded by Mr. Hennessey and carried.

TRAIN BRAKE AND SIGNAL EQUIPMENT

Committee:—R. B. Kendig, chairman; T. L. Burton, B. P. Flory, E. W. Pratt, R. K. Reading.

Piping Arrangement for Steel Cars.

From replies received to Circular of Inquiry requesting certain information concerning the foundation brake arrangement on steel cars and steel-underframe cars, it would seem, having in mind the greatest degree of accessibility, that the practice of locating brake pipes is, in a general way, uniform. Since this subject was assigned to your committee two years ago, the railroad car designers, the air-brake manufacturers and the car manufacturers have had considerable additional experience in designing air-brake pipe arrangements. There are so many different types of steel cars now in existence, to say nothing of the future, that the committee believes it could not present piping arrangements that would be suitable for all cases, and no recommendation of a piping arrangement for steel cars is, therefore, deemed necessary.

AIR-BRAKE DEFECT CARD.

The committee would make the following recommendations:

(a) A defective air-brake card, as shown by Fig. 1, to take the place of the present air-brake cutout card and defective air-brake card.

(b) A revision of the defects enumerated on the present air-brake cutout card and air-brake repair card to read as shown on the proposed defective air-brake card, Fig. 1.

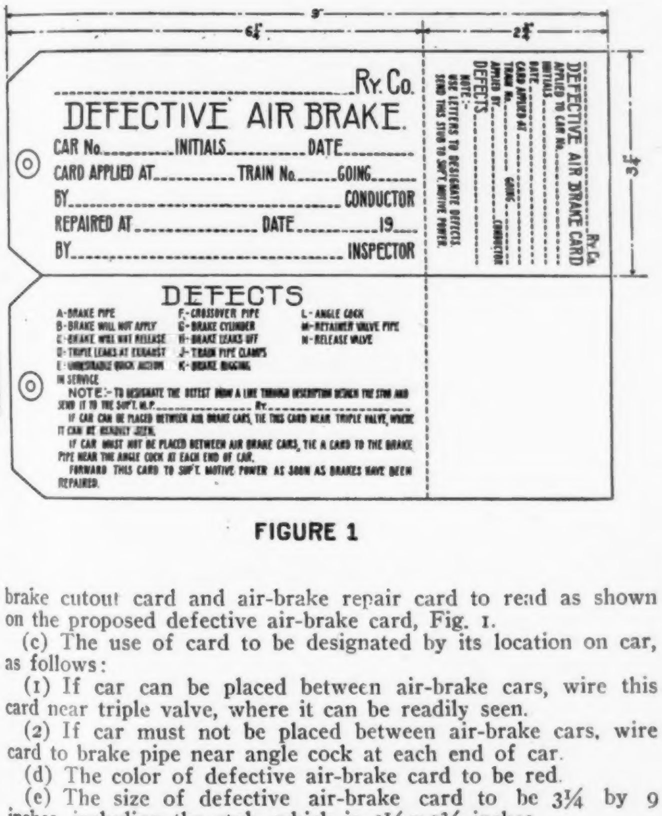


FIGURE 1

(c) The use of card to be designated by its location on car, as follows:

(1) If car can be placed between air-brake cars, wire this card near triple valve, where it can be readily seen.

(2) If car must not be placed between air-brake cars, wire card to brake pipe near angle cock at each end of car.

(d) The color of defective air-brake card to be red.

(e) The size of defective air-brake card to be 3¼ by 9 inches, including the stub, which is 3¼ x 2¾ inches.

(f) Card to be fitted with eyelet, as shown in Fig. 1, and each card supplied with suitable wire for attaching to car.

EFFICIENT TRUCK BRAKE FOR CARS EQUIPPED WITH ALL-STEEL OR STEEL-TIRED WHEELS.

From a compilation of the data received in answer to Circular of Inquiry of the Wheel Committee the committee has assumed, for the purpose of consideration of this subject, a diameter of 30 inches when wheel is worn to limit.

By making several truck-brake layout drawings it was found that the additional brake travel due to decreased diameter of wheels can be readily taken up by means of additional holes in the bottom connection rod jaws.

The committee recommends that sketch of bottom rod, detail Fig. 2, to be shown on Plate 18, to cover bottom-rod details for cars having inside-hung brakes and equipped with all-steel or steel-tired wheels; the inside pin holes to be used with new wheels.

IV.—ANGULARITY OF BRAKE-BEAM HANGERS.

This subject is somewhat involved by the increasing use of all-steel and steel-tired wheels on freight cars, with the consequent difference in diameter of wheels when new and worn to limit.

The Wheel Committee has made recommendations as to maximum diameter for all-steel and steel-tired wheels, but has left open the question of diameter when wheel is worn to limit. It is obvious that an angle of brake beam hanging suitable for a new 33-inch wheel would be objectionable when wheel is worn to limit, and some compromise angle would have to be selected.

The committee recommends, therefore, that the question of advancing to standard the before-mentioned practice be deferred

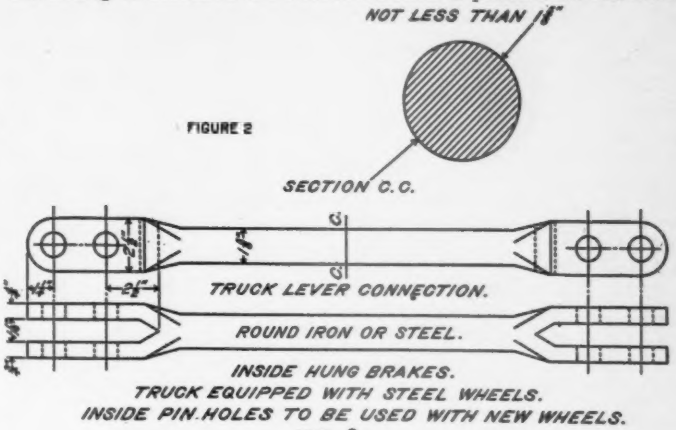


FIG. 2.

until it has more data and time for consideration of the subject.

V.—TRIPLE VALVE TEST RACK AND CLEANING AIR BRAKES.

In pursuance to the suggestion outlined at the 1909 convention, a member of the Association's Committee on Train Brake and Signal Equipment had placed in freight and coal service on the Philadelphia & Reading Railway, and the Central Railroad Company of New Jersey, during the latter part of 1909 and the early part of 1910, 1,500 Westinghouse K-2 triple valves containing no lubricant: also, for comparative test, 1,000 additional triple valves which had been lubricated with a suitable composition of oil and graphite.

A large number of the lubricated and non-lubricated valves were removed from the cars after they had been in service for twelve to fourteen months, and were carefully inspected and tested before and after cleaning.

Briefly stated, the investigation thus far shows the following results:

Lubricated Valves.—After being in service twelve to fourteen months, 65.66 per cent. of the valves tested passed all test before they were cleaned; 21 per cent. failed on charging the auxiliary reservoir in the prescribed time because of the valves being dirty.

After cleaning, 86.36 of the lubricated valves tested passed all test.

Non-lubricated Valves.—After being in service twelve to fourteen months, 37.2 per cent. of the valves passed all test before cleaning; thirty-six per cent. failed on charging the auxiliary reservoir in the specified time.

After cleaning, 90.69 per cent. of the non-lubricated valves tested passed all test.

All of the slide valves, slide-valve seats, bushing and packing rings were highly polished and showed no ill effects from lack of lubricant.

Eliminating the defects that caused the lubricated and non-lubricated valves to pass the prescribed test which would not be influenced by the application of lubricant, there was no appreciable difference in the performance of the lubricated and non-lubricated valves.

While the committee does not feel that the scope of its investigation has been sufficiently broad to justify any definite recommendations on discontinuing the application of lubricant to triple valves, it does feel that the subject is of sufficient importance to justify a more thorough investigation than the committee has been able to make.

As a conclusion to its report, the committee presents the following proposed instructions on the inspection, repairs and test of freight brakes, and suggests its adoption as recommended practice.

ANNUAL REPAIRS TO FREIGHT-CAR AIR BRAKES.

INSPECTION.

Cleaning and Lubricating Triple Valves.

The triple valve should be removed from the car for cleaning in the shop, and should be replaced by a triple in good condition. It should be dismantled and all the internal parts, except those with rubber seats and gaskets, cleaned with gasoline, then blown off with compressed air and wiped dry with a cloth.

The slide valve and graduating valve must be removed from the triple-piston and retarded release parts from the body in order that the service ports in the slide valve and other parts may be properly cleaned.

No hard metals should be used to remove gum or dirt or to loosen the piston packing ring in its groove.

The feed groove should be cleaned with a piece of wood, pointed similar to a lead pencil. Bags or cloth should be used

for cleaning purposes, rather than waste, as waste invariably leaves lint on the parts on which it is used.

In removing the emergency valve seat, care must be exercised not to bruise or distort it.

Particular attention should be given the triple-piston packing ring. It should have a neat fit in its groove in the piston, and also in the triple-piston bushing; once removed from the piston, or distorted in any manner, it should be scrapped. The fit of the packing ring in its groove and bushing and the condition of the bushing should be such as to pass the prescribed tests.

The graduating stem should work freely in the guide nut. The graduating spring and the retarded release spring in retarded release triple valves must conform to standard dimensions and be free from corrosion. The thread portion of the graduating stem guide should be coated with oil and graphite before re-applying it to the triple cap.

The triple valve piston and the emergency valve must be tested on centers provided for the purpose to insure them being straight. The emergency valve rubber seat should invariably be renewed unless it can plainly be seen to be in first-class condition, which is seldom the case. A check-valve case having cast-iron seat should be replaced with a case having a brass seat.

The cylinder-cap gasket and check-valve case gasket to be carefully examined and cleaned with a cloth; but should not be scraped. All hard or cracked gaskets to be replaced with new ones.

Standard gaskets as furnished by the air-brake manufacturers should be used. The use of home-made gaskets should be avoided, as the irregular thickness results in leakage and causes triple-piston stem to bend or break.

The tension of the slide-valve spring should be regulated so that its contour will be such as to bring the outer end ⅛-inch higher than the bore of the bushing when the outside end of the spring touches bushing when entering.

Before assembling the parts after cleaning, the castings and ports in the body of the triple valve should be thoroughly blown out with compressed air, and all parts of the triple not elsewhere provided for known to be in good condition.

Lubricate the seat and face of the slide valve and slide-valve graduating valve with high-grade very fine dry graphite, rubbing it onto the surface and the upper portion of the bushing where the slide-valve spring bears, so as to make as much as possible adhere to and fill up the pores of the brass, leaving a very thin coating of free graphite. The parts to be lubricated with graphite must be free from oil or grease.

Rub the graphite in with a flat-pointed stick over the end of which a piece of chamois skin has been glued. At completion of the rubbing operation a few light blows on the slide valve will leave the desired light coating of loose graphite.

The triple-valve piston packing ring and its cylinder should be lubricated with either a light anti-friction oil or a suitable graphite grease as follows:

Apply a light coating to the packing ring and insert the piston and its valves in the body, leaving them in release position, then lubricate the piston-cylinder and move the piston back and forth several times, after which remove the surplus from the outer edge of the cylinder to avoid leaving sufficient lubricant to run on the slide valve or seat while the valve is being handled or stored ready for use.

No lubrication to be applied to the emergency piston, emergency valve or check valve.

All triple valves after being cleaned or repaired must be tested, preferably on a rack conforming to the attached print, and pass the test prescribed under the subject of "Triple Valve Tests" before being placed in service.

Should any of the triple-valve bushings require renewing, such work should be done by the air-brake manufacturers.

Triples in which packing rings are to be renewed, slide valve or graduating valves renewed or faced, if the latter is of slide type, should be sent to a central point or general repair station for repairs.

When applying the triple valve to the auxiliary reservoir, the gasket should be placed on the triple valve, not the reservoir.

CLEANING.

Lubricating and Inspection of the Brake Cylinders.

First, secure the piston rod firmly to the cylinder head, then after removing the non-pressure head, piston rod, piston head and release spring, scrape off all deposits of gum and dirt with a putty knife or its equivalent, and thoroughly clean the removed parts and the interior of the cylinder with waste saturated with kerosene.

Packing leathers must not be soaked in kerosene oil as it destroys the oil filler placed in the leather by the manufacturers, opening the pores of the leather and causing them to become hard.

Particular attention to be paid to cleaning the leakage groove and the auxiliary tube. Triple valve must be removed when the auxiliary tube is being cleaned.

The expanding ring when applied in the packing leather should be a true circle and fit the entire circumference, and have an opening of from 3-16 to ¼ inch; when removed from the cylinder the ring opening should be 1½ to 1 9-16 inches, and with this opening, of course, will not be a true circle.

A packing leather which is worn more on one side than the other should be replaced with a new one of uniform thickness, or turned so as to bring the thin side away from the bottom of the cylinder. The piston should be turned each time the cylinder is cleaned. In putting a packing leather on piston, it should be so placed as to bring the flesh side of the leather next to the cylinder walls.

Follower studs to be firmly screwed into the piston heads, and nuts to be drawn up tight before replacing the piston.

The inside of the cylinder and packing leather to be lightly coated with a suitable lubricant, using not more than 4 ounces nor less than 3 ounces per cylinder.

Part of the lubricant should be placed on the expander ring, and the adjacent side of the packing leather, thus permitting the air pressure to force the lubricant into the leather at each application of the brake.

No sharp tools should be used in placing the packing leather into the cylinder.

After the piston is entered and before the cylinder head is replaced, the piston rod should be slightly rotated in all directions, about three inches from the center line of the cylinder, in order to be certain that the expanding ring is not out of place.

In forcing the piston to its proper position in the cylinder, the packing leather will skim from the inner walls of the cylinder any surplus lubricant that may have been applied. It has been found good practice to again extract the piston and remove the surplus lubricant.

All stencil marks to be scraped off or painted over with black paint. The place of cleaning, day, month and year to be stenciled with white paint, preferably on both sides of the cylinder or auxiliary reservoir, or if this is not readily visible, in a convenient location near the handle of the release rod.

The bolts and nuts holding the cylinder and reservoir to their respective plates and the latter to the car, to be securely tightened.

The brake cylinder to be tested for leakage after cleaning, preferably with an air gauge, which can be done by attaching the gauge to the exhaust port of the triple valve before connecting the retainer pipe, or where the latest type retainers are used the gauge can be connected to the exhaust port of the retaining valve. In either case, the gauge will indicate cylinder leakage on releasing the triple valve after making an application, and when atached to the retainer valve it will also test the retainer and retaining-valve pipe.

Brake-cylinder leakage should not exceed five pounds per minute, from an initial pressure of fifty pounds.

Each time the triple valve and the brake cylinder are cleaned, the brake pipe, brake-pipe strainer and branch pipe should be thoroughly blown out and the triple valve strainer cleaned before recoupling the branch pipe to the triple valve. If a dirt collector is used, the plug should be removed, the accumulation blown out and the threaded portion of the plug coated with oil and graphite before replacing.

All union gaskets should be made of oil-tanned leather. The use of rubber in unions should not be permitted.

Piston travel should be adjusted to not less than 5½ nor more than 7 inches.

ADDITIONAL INSPECTION AND REPAIRS TO CARS.

When the brake cylinder and triple valve is cleaned, the following additional work should be done to the car:

Retaining valve cleaned by removing the cap, wiping or blowing out all dirt and seeing that the valve and its seat are in good condition, the retaining position exhaust port open and the valve proper is well secured to the car in a vertical position, pipe clamps applied where missing and tightened where loose, hose and angle cocks turned to their proper position. Pipe joints, air hose, release valves, angle and stop cocks should be tested by painting the parts with soap suds while under an air pressure of not less than 70 pounds, preferably 80 pounds, and defective parts repaired or removed.

See that there are no broken or missing brake shoes, brake beams or foundation brake gear, and if the car belongs to a foreign road, a repair card should be made out covering all work that has been done and attached to the car, as per M. C. B. Rules.

The inspection and repairs which have been mentioned should be made to all cars at least once in twelve months.

TRIPLE-VALVE TESTS AND INSTRUCTIONS FOR OPERATING TRIPLE-VALVE TEST RACK.

Mounting Triple Valves for Testing.

With the triple-valve gasket applied to the face of the triple-valve flange, place the latter against the face of the stand in a vertical position and open cock "X," as shown on attached piping diagram, Fig. 3. Connect the brake pipe to the triple, then open cock "Z."

Before attaching triple valves suitable for use with 8-inch brake cylinders, insert in the auxiliary reservoir end of the

valve the friction-increaser extension piece, suitable for the valve under test.

Two triple-valve stand face plates are required for each test rack to permit the testing of all types of freight triple valves.

Plate No. 1 is for use when testing triple valves for 8-inch cylinders.

Plate No. 2 is for triple valves used on 10-inch cylinders.

If it is found necessary to repeat any test which has necessitated a reduction of auxiliary reservoir pressure, valve "B" may be moved to position No. 2, which provides a by-pass around the triple valve from the brake pipe to the auxiliary reservoir, thereby permitting a quick recharge.

Test No. 1.—Charging Test for Triple Valves.

Commencing the tests with cocks 2, 3, 7 and 9 open, all other numbered cocks closed, valve "V" in position No. 3 (lap), valve "A" in position No. 1, auxiliary reservoir empty and main reservoir pressure 80 pounds pressure, proceed as follows:

Close cock No. 7 and open No. 1, and with 80 pounds pressure in the brake pipe note the time required to charge the auxiliary reservoir to specified pressure, as given in the following table:

(NOTE.—If, during this test or Test No. 2 (LeakageTest), any considerable leakage is discovered, the charging test must be repeated.)

With break-pipe pressure maintained at 80 pounds, the triple valves should charge the auxiliary reservoir as follows:

CHARGING AUXILIARY RESERVOIR.

	From 0 to 30 Lbs. Seconds.		From 0 to 70 Lbs. Seconds.	
Westinghouse Triple Valve	Min.	Max.	Min.	Max.
8-inch non-quick service	21	28	58	78
10-inch non-quick service	13	17	34	44
8-inch quick service	32	42	100	120
10-inch quick service	19	24	60	72
	From 0 to 30 Lbs. Seconds.		From 0 to 70 Lbs. Seconds.	
New York Triple Valve	Min.	Max.	Min.	Max.
8-inch non-quick service	..	..	61	82
10-inch non-quick service	..	..	46	61
8-inch quick service	..	..	100	120
10-inch quick service	..	..	65	80

These tests give practically the same results, and the time of charging from 0 to 30 pounds is given simply to save time in making the test.

Test No. 2.—Leakage Test.

Commencing each of the sections of Test No. 2, with cocks 1, 2, 3 and 9 open, all other numbered cocks closed, valve "B" in position No. 3 (lap), valve "A" in position No. 1, and auxiliary reservoir charged to 80 pounds, proceed as follows:

Sec. "A," Test No. 2.—Westinghouse Triple Valves and New York Quick-service Triple Valves. Leakage at Exhaust in Emergency Check-Valve and Cylinder-Cap Gasket ***Leakage.***

Operate the triple valve two or three times in quick action by closing and opening cock No. 1; finally leaving it closed.

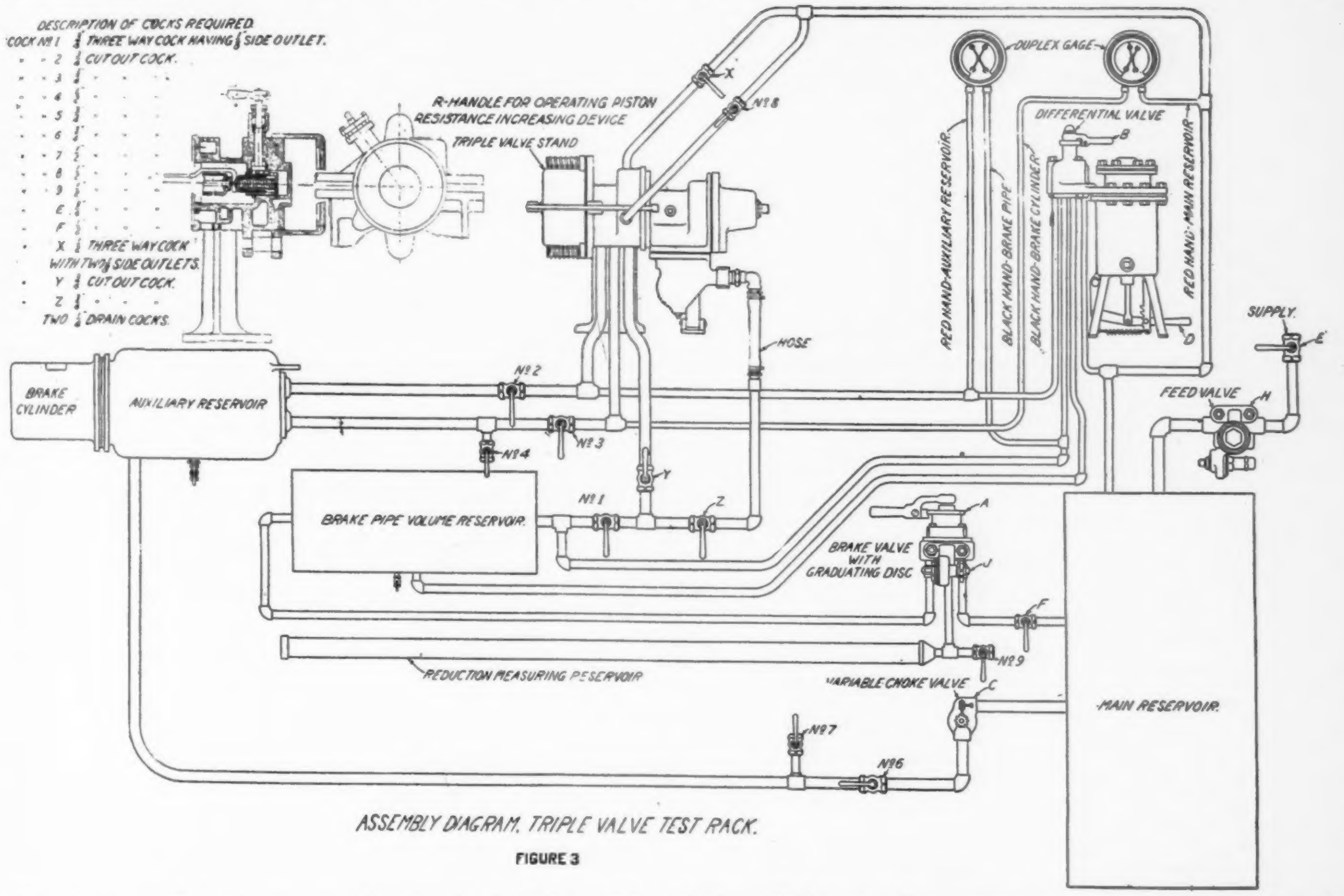
Coat the exhaust port of triple valve with soapsuds to ascertain if leakage exists past the slide valve or bushing to the exhaust with the piston and slide valve in emergency position.

Close cocks 2 and 3 and note the rate of fall of pressure indicated by the brake-cylinder gauge hand, which is now connected only with the small volumes between cocks 2 and 3 and the triple valve. A leakage greater than 5 pounds in 10 seconds indicates either excessive check-valve leakage or that the piston does not seal against the cylinder-cap gasket.

At the completion of this test, open cocks 2 and 3 in the order given.

Sec. "B," Test No. 2.—Leakage at Exhaust in Release Slide Valve of Emergency-valve Leaking.

Open cock 1, and after the brake-cylinder pressure is exhausted close cock 3 and again coat the exhaust port with soapsuds to determine if there is any leakage from the auxiliary reservoir to the brake cylinder past the slide valve when the triple valve is in release position, or from the brake pipe to the



ASSEMBLY DIAGRAM, TRIPLE VALVE TEST RACK.

FIGURE 3

brake cylinder past the emergency valve or its seat, when the differential on the emergency valve is high. Open cock 3, then paint the body of the triple valve with soapsuds to determine if leakage exists direct to the atmosphere through castings or gaskets.

If leakage is discovered at the triple exhaust in release position, determine if it is from the auxiliary reservoir or brake pipe in the following manner:

Move valve "A" to position No. 8 and open cock 7 until the brake pipe and auxiliary reservoir are empty; then with the valve "J" in position No. 3, place a soap bubble on the exhaust port and place valve "A" in position No. 2. If no leakage is found at the exhaust, advance valve "J" by stages from position to position until a brake-pipe pressure of 10 pounds is obtained. Any leakage from the exhaust while the auxiliary reservoir is without pressure must be from brake pipe, past the emergency valve. Therefore, if no exhaust leakage is found and leakage did exist while the auxiliary reservoir was charged, it indicates defective slide valve. At the completion of this test, close cock No. 7 and move valve "A" to position No. 1, recharging auxiliary reservoir.

Sec. "C," Test No. 2.—Graduating-valve Leakage.

Move valve "A" to position No. 7 until a brake-cylinder pressure of from 20 to 30 pounds is obtained. Then return valve "A" to position No. 2 and close cock 3. If the brake-cylinder pressure then increases without leakage at the exhaust port, it is proper to assume that the graduating valve is leaking, providing it has been determined by the preceding tests that the emergency valve is tight. If leakage at the exhaust occurs during this test, which will be determined by placing a soap bubble on the exhaust, the leakage may be either from

slide valve or graduating valve. The rate of rise of pressure on the brake cylinder gauge, resulting from graduating-valve leakage, must not exceed 5 pounds in 20 seconds. This comparatively rapid rate of rise is permissible owing to the extremely small volume of the section of brake-cylinder pipe into which the leakage is occurring.

At the completion of test, open cock 3 and move valve "A" to position No. 1.

Sec. "A," Test No. 2.—Non-quick Service. New York Triple Valve. Leakage at Exhaust in Emergency. Check-valve, Quick-action Valve and Cylinder-cap Gasket Leakage.

Operate the triple valve two or three times in quick action by closing and opening cock 1, finally leaving it closed.

Coat the exhaust port of triple valve with soapsuds to ascertain if leakage exists past the exhaust valve or bushing, with the piston and slide valve in emergency position. Close cocks 2 and 3. If the brake-cylinder gauge now indicates leakage greater than 5 pounds in 10 seconds the leakage is excessive, and is usually due to imperfect seating of the check valve or quick-action valve, or to the main piston not making a tight joint on the main-cylinder gasket. To locate the defect place soap bubbles on the vent ports. No leakage at these points indicates that the leakage is past the main-cylinder gasket. If leakage is found at the vent ports open cocks 1, 2 and 3 and recharge the auxiliary reservoir to 80 pounds, then move valve "A" to position No. 7 until the brake-pipe pressure is reduced to 10 pounds and return valve "A" to position No. 3. Close cock 2, and if the quick-action valve is leaking the brake will immediately release. If it does not, the leakage is past the check valve.

At the completion of this test, if no leakage were found, open cocks 1, 2 and 3, and if leakage were discovered open cock 2 and move valve "A" to position No. 1.

Sec. "B," Test No. 2.—Exhaust-valve Leakage in Release; also Vent-valve and Quick-action Valve Leakage.

Close cock 3 and coat the exhaust port with soapsuds to determine if there is any leakage from the auxiliary reservoir past the exhaust valve, or graduating valve or triples, having this valve tandem with the exhaust valve, when the triple is in release position. If exhaust leakage is found, the triple under test has tandem exhaust and graduating valves, determine which valve is leaking by making graduating-valve leakage test.

Sec. "C," Test No. 2.—Graduating-valve Leakage.

Move valve "A" in position No. 7 until a brake-cylinder pressure of from 20 to 30 pounds is obtained. Then return valve "A" to position No. 3 and close cock 3. If the brake-cylinder pressure then increases without leakage at the exhaust port, it is proper to assume that the graduating valve is leaking. The rate of rise of pressure on the brake-cylinder gauge, resulting from graduating-valve leakage, must not exceed 5 pounds in 20 seconds. This comparatively rapid rise is permissible owing to the extremely small volume of the section of brake-cylinder pipe into which the leakage is occurring.

If leakage at the exhaust occurs during this test, which will be determined by placing a soap bubble on the exhaust, the leakage is by the exhaust valve instead of the graduating valve.

At the completion of the test open cock 3 and move valve "A" to position No. 1.

Test No. 3.—Test for Type "K" Triple Valves for Retarded-Release Feature; for Both Westinghouse and New York Triple Valves.

Commencing the test with cocks 1, 2, 3 and 9 open, all other numbered cocks closed, auxiliary reservoir charged to 80 pounds, valve "B" in position No. 3 (lap), lever "D" in position No. 2 and valve "A" in position No. 3 (lap), proceed as follows:

Move valve "A" to position No. 7 until brake-pipe pressure is reduced 20 pounds, then return it to position No. 3; place valve "J" in position No. 4; valve "B" in position No. 1, and valve "A" in position No. 2. This should move the triple-valve parts to normal (full release) position.

If the triple valve moves to retarded-release position, which is indicated by a contracted exhaust and slow release of brake-cylinder pressure, it indicates a weak or broken retarded release spring, or undue friction in the retarding device.

Following this test, recharge the system to 80 pounds by moving valve "A" to position No. 1 and valve "B" to position No. 2.

When the brake pipe and auxiliary reservoir are charged to 80 pounds move valve "A" to position No. 7 until brake-pipe pressure is reduced 20 pounds, then return it to position No. 3. Place valve "J" in notch No. 8, lever "D" in notch No. 4, valve "B" in position No. 1, and valve "A" in position No. 2.

Under these conditions the triple-valve piston and slide valve should be forced to retarded-release position. If this does not occur it indicates that the retarded-release spring is not standard or the retarding devices have excessive friction. Completing test, place valve "B" in position 3 and valve "A" in position 1.

Sec. "A," Test No. 4.—Application Test for Both Westinghouse and New York Triple Valves.

If for any reason it is desired to make this test following an application and release produced by closing and opening cock 1, or the auxiliary reservoir has just been charged by opening cock 1, this test should be preceded by an application and release with valve "A," for the purpose of insuring the slide valve being in its normal position.

Commencing the test with cocks 1, 2, 3 and 9 open, all other numbered cocks closed, valve "A" in position No. 1, valve "B" in position No. 2, and lever "D" in notch 3, then with the auxiliary reservoir charged to 80 pounds, proceed as follows:

To test triple valves for 8-inch cylinders, place valve "B" in position No. 4 and valve "A" in position No. 5.

To test triple valves for 10-inch cylinder, place valve "B" in position No. 4 and valve "A" in position No. 6.

In all of these tests the triple valve should move to application position without causing a discharge of air from the vent port of valve "B."

A failure to apply under the conditions specified indicates either excessive friction, which will be shown by an exhaust from the vent port of valve "B"; a leaky packing ring, which will be discovered later by the packing-ring leakage test; too large a feed groove in the cylinder, or a combination of two or more of these defects. Should the triple valve fail to apply and no exhaust occur from valve "B," the indications are that the back flow of air from the auxiliary reservoir to the brake pipe is too rapid to permit the required differential.

At the completion of this test move valve "B" to position No. 3 and valve "A" to position No. 1.

Sec. "B."—Quick-service Test (for Quick-service Triple Valves Only) for Both Westinghouse and New York Triple Valves.

Commencing the test with cocks 1, 2, 3 and 9 open, all other numbered cocks closed, valve "A" in position No. 1, valve "B" in position No. 3 and auxiliary reservoir charged to 80 pounds, proceed as follows:

Close cock 9 and move valve "A" to position No. 7 for all 8-inch and 10-inch triple valves. The brake-cylinder pressure obtained should not be less than 5 pounds greater than that which will be obtained by subjecting to the same test triple valves which do not contain the quick-service features.

At the completion of this test move valve "A" to position No. 1 and open cock 9.

Test No. 5.—Packing-ring Leakage Test for Both Westinghouse and New York Triples.

Release Test, Sec. 1.—Commencing with cocks 1, 2, 3 and 9 open, all other numbered cocks closed, valve "A" in position No. 1, valve "B" in position No. 3, and the auxiliary reservoir charged to 80 pounds, proceed as follows:

Place the valve "A" in position No. 7 until the brake-pipe pressure is reduced 15 pounds, then return to position No. 3 (lap). Place valve "J" in position No. 2, lever "D" in notch No. 1, and valve "B" in position No. 1; close cocks 2 and 3 and move valve "A" to position No. 2. If the discharge does not occur promptly from the vent port of valve "B," advance valve "J" from position to position until the discharge begins, then note the rate of increase of pressure on the auxiliary reservoir gauge, which must not exceed 5 pounds in 30 seconds.

During this test there must be a steady exhaust of air from the vent port of valve "B" to insure the proper differential being maintained on the triple-valve piston. If, in making this test, the triple valve for the 8-inch cylinder releases or indicates excessive ring leakage, make another test, beginning with moving handle "R" to the right, after making the proper brake-pipe reduction and before starting to increase the brake-pipe pressure. Immediately after the test is completed, handle "R" should return to its normal left position.

Should it occur that the friction of the triple valves for the 10-inch brake cylinder is so low as to continue to permit the triple to release, the reduction for the application may be changed from 15 to 10 pounds. When this is done, special attention should be given to determining if the graduating valve is right, as it must be, to permit an accurate test.

At the completion of this test place valve "B" in position No. 3, open cocks 2 and 3 and place valve "A" in position No. 1.

Test No. 6, Sec. 2.—Friction Test. Release Test for Both Westinghouse and New York Valves.

Commencing the test with cocks 1, 2, 3 and 9 open and all other numbered cocks closed, valve "A" in position No. 1, valve "B" in position No. 3, auxiliary reservoir charged to 80 pounds.

Place lever "D" in notch 3 for all triple valves undergoing the test; proceed as follows:

Place valve "A" in position No. 7 until the brake-pipe pressure is reduced to 10 pounds, then return it to position No. 3. Place valve "J" in position No. 1, valve "B" in position No. 1, and move valve "A" to position No. 2. Under these conditions the triple valve should release. A failure to release should be accompanied by a discharge at the vent port of valve "B," which indicates that the frictional resistance to the movement of the packing ring and slide valve is excessive.

If the triple valve does not release and valve "B" fails to open its exhaust, leakage is occurring from the brake pipe, which will necessitate advancing valve "J" from position to position, remaining in each position 30 seconds, until the triple valve releases or the exhaust in valve "B" opens.

At the completion of the test place valve "B" in position No. 3 and valve "A" in position No. 1.

Test No. 7, Sec. "A."—Service-port Capacity Test for Westinghouse Triple Valves and Quick-service New York Triple Valves.

Commencing with cocks 1, 2, 3, 4 and 9 open, valve "A" in position No. 1, valve "B" in position No. 3, place valve "C" in position required for the triple valve under test, as indicated:

Notch No. 1.—For 8-inch triple valves.

Notch No. 2.—For 10-inch triple valves.

During this test the brake-pipe pressure should not drop, except that in the case of the quick-service triple valves there will, of necessity, be a slight drop, which must not exceed 2 pounds.

Place valve "B" in position No. 2 and move valve "A" to position No. 3, open cock 7 until brake-pipe and auxiliary-reservoir pressures are reduced to 50 pounds, then close cock 7. Move valve "B" to position No. 3 and open combination cock 6 and quick-opening valve, leaving it open 3 seconds. This test should not produce quick action. If it does, it indicates a restriction in the service port, or a weak or graduating spring.

SEC. B.—Duplicate the tests specified under Sec. A, placing the wheel of valve "C" in the position as indicated.

Notch No. 3.—For 8-inch triple valves.

Notch No. 5.—For 10-inch triple valves, excepting Westinghouse non-quick service, with which use notch 7.

This should result in the triple valve moving to emergency position. Failure to do so indicates too close a fit of the emergency piston.

At the completion of the test close cock 4 and combination cock 6 and quick-opening valve, move valve "A" to position No. 1.

Test No. 7, Sec. "A."—Service-port Capacity Test for New York Non-quick Service Triple Valves.

Commencing with cocks 1, 2, 3, 4 and 9 open, valve "A" in position No. 1, valve "B" in position No. 3, place valve "C" in position required for the triple valve under test, as indicated.

Notch No. 1.—for 8-inch triple valves.

Notch No. 2.—For 10-inch triple valves.

Place valve "B" in position No. 2 and move valve "A" to position No. 3. Open cock 7 until brake pipe and auxiliary reservoir pressure are reduced to 50 pounds, then move valve "B" to position No. 3 and open cock 6 quickly.

NOTE.—During this test the triple valve should move to service position, the brake-pipe pressure must not drop and there must be no discharge of air from the vent ports.

Should the triple valve move to emergency position, it indicates a restriction in the service ports or a weak vent-valve spring.

SEC. B.—Duplicate the test specified under Sec. A, placing the wheel of valve C in the position as indicated for the triple valve under test.

Notch No. 3.—For 8-inch triple valves.

Notch No. 5.—For 10-inch triple valves.

This should result in the triple valve moving to emergency position, causing a strong blast of air from the vent ports and a brake-pipe reduction of at least 3 pounds. Failure to do so indicates a too loose fit of the vent-valve piston packing.

AIR-BRAKE HOSE COUPLINGS.

PART I.

Air-brake Hose Couplings and Packing Rings.

In its investigations the committtee assumed that all air-brake hose couplings and packing rings now in use were supplied by the Westinghouse Air Brake Company and the New York Air Brake Company, or in accordance with their standard dimensions, and therefore the question of the best possible interchange of proposed standard and existing couplings and rings has received due consideration.

For the purpose of determining whether there are sufficient variations in the dimensions of various makes of couplings to justify the Association in adopting a standard with a view of securing a more satisfactory interchange, more than five thousand new and used couplings have been gauged and tested. This investigation revealed the fact that the dimensions of couplings which should be common to all makes vary appreciably in couplings supplied by different manufacturers.

Enlarged drawings have also been made showing the variation in the principal dimensions employed by the Westinghouse Air Brake Company and the New York Air Brake Company in the design of their respective coupling and packing ring. Outlines of the former and details of the latter are shown in Fig. 4 (not reproduced), from which it will be seen that there is a difference of 1-64 inch in the nominal height of a Westinghouse and a New York packing ring. Also, there is 3-64 inch difference in one of the principal dimensions of the couplings affecting the compression of the rings.

When two Westinghouse couplings, with Westinghouse packing ring in each, are coupled together, the nominal compression of each packing ring is 3-128 inch. When the couplings are pulled apart (as is the case when cars are uncoupled without first parting the hose) the faces of the hose couplings are 1-32 inch apart.

With two New York couplings, having a New York packing ring in each, coupled together, the compression of each ring is nominally 1-32 inch; and when the couplings are pulled apart, the space between the faces of the couplings is only 1-64 inch.

If Westinghouse packing rings are used in New York couplings, the compression of each ring will be 3-64 inch, or 1-64 inch greater than when New York packing rings are used in New York couplings. A combination of New York packing rings and Westinghouse couplings will reduce the nominal compression of the latter to 1-128 inch.

The permissible variation in the nominal compression of the rings, with the existing standards of the air-brake manufacturers, is therefore in the ratio of 6 to 1, or 600 per cent., which, in the judgment of the committee, justifies the Association in considering the adoption as standard, or recommended practice, such dimensions relating to air-brake hose couplings and packing rings as will insure greater protection against leakage and lessen the damage to hose when "pulled apart" than is now possible.

NEW PROPOSED STANDARD COUPLING.

Fig. 5 shows the detail drawing, as submitted by the Air-hose Committee in 1909, revised.

The revision consists of an outline of the reinforced guard arm, a 1-16 inch radius at the back of the groove for the packing ring, and of a second (3-16-inch and 5-32-inch) radius in the groove of the guard arm and at the outer lug, to provide suitable clearance at point "B."

For convenient reference, the packing ring as recommended in 1909 is also shown in detail in Fig. 5.

Leakage at the packing ring and damage to hose when "pulled apart" will depend largely upon the permissible varia-

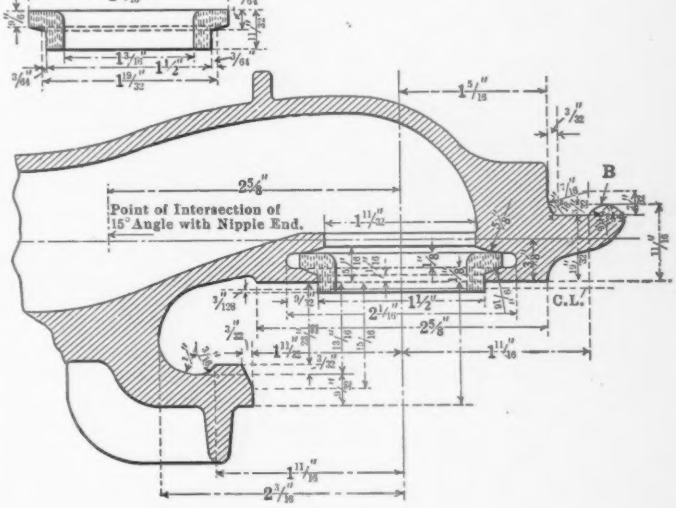


FIG. 5.

tion in nominal dimensions to meet manufacturers' requirements. The question of maximum variation in nominal dimensions affecting the compression of the ring and the clearance between faces of coupling has therefore been thoroughly investigated by (as previously stated) "gauging and testing over five thousand couplings" and a number of packing rings. Couplings which were found to slightly vary from the manufacturer's standard were tested under air pressure on a pulling machine, with which could be approximated the strains to which the hose is subjected in service through the slack action and curving of cars. Notwithstanding the fact that no tests were made with frozen hose (which is, perhaps, the severest service test for ring leakage that can be made), the investigation leads to the conclusion that the air-brake manufacturers can be depended upon to supply their hose couplings and rings with a degree of accuracy that will insure satisfactory service.

This conclusion does not apply, however, to packing rings secured in the open market. In gauging and testing a large number of sample packing rings which were supplied by various rubber companies, less than ten per cent. of them were found to be fit for service. A number of these sample rings were represented by the rubber manufacturers to be "M. C. B. Standard," "perfect samples," etc.

If the members of the Association care to consider securing packing rings in the open market, then suitable minimum and maximum gauges for them should first be adopted (consideration of which does not come within the scope of the committee's investigation on couplings and rings).

It has been suggested that the Association should adopt minimum and maximum dimensions for the couplings as a whole.

This would affect further developments in the device, such as are now being made by the two leading air-brake companies in what may be termed a "hose-protector coupling," with which it is intended to minimize the tension in the hose when pulled apart. The committee has therefore confined its recommendations to nominal dimensions affecting the interchange of couplings and rings.

Summary.

Summarizing, it can be said that two couplings and packing rings conforming to the dimensions shown in Fig. 5 will couple together as satisfactorily and with equal assurance against leakage at the packing ring, and with as little damage to hose when pulled apart, as is now had with couplings and rings conforming to the standards of the Westinghouse Air Brake Company.

One of the proposed M. C. B. couplings and rings, as shown in Fig. 5, will interchange with couplings and rings conforming to the standard of the New York Air Brake Company more satisfactorily and with greater assurance against leakage and damage to hose when pulled apart than is now possible with a Westinghouse and New York coupling coupled together.

A proposed M. C. B. coupling and packing ring (as shown in Fig. 5) and a Westinghouse coupling and packing ring will interchange at satisfactorily and with equal assurance against leakage and damage to hose when pulled apart as will two couplings conforming to the standard of the Westinghouse Air Brake Company.

Part II.

Gauges for Air-brake Hose Couplings.

The question of gauges for used air-brake hose couplings has been investigated with the view of determining proper contour lines of the gauges. A number of used couplings have been gauged (and subsequently tested) with gauges of such proportions and dimensions as to provide for condemning couplings with guard arms and lugs distorted or worn from 1-128 inch to 1-32 inch.

The committee does not feel justified in suggesting the adoption of the proposed dimensions without first gauging (with the proposed gauges) a sufficient number of couplings to confirm the committee's judgment in the premises. The committee therefore desires to report "progress" on the question of gauges for air-hose couplings and respectfully asks for further time in which to complete its investigation.

Discussion.—Some objection was raised to the recommendation of wiring the defect card on to the car instead of tacking it up in an exposed place. It was explained by the committee that this matter had been given very careful attention and it was decided that to have it wired on was better practice.

F. W. Brazier (N. Y. C.) drew attention to the inferior gaskets which a number of roads are applying and recommended that all gaskets found which were not absolutely standard be thrown into the scrap heap.

Considerable discussion was raised in connection with the two-hole connection in the truck lever connection. The consensus of opinion seemed to be that more holes should be shown on this drawing, and a motion was finally carried that it should be revised to show three holes at each end.

W. F. Bentley (B. & O.) recommended that the word "preferable" be eliminated from the section of the report that referred to the matter of testing triple valves on the test rack after cleaning or repairing. Mr. Burton drew attention to the fact that this is recommended practice in any case, and would not be binding even without the word "preferable."

A motion was carried that the recommendations of the committee, as to the defect card, the bottom rod, the annual repairs to freight car brakes and the adoption of a hose coupling and packing ring be referred to letter ballot for adoption as recommended practice.

RULES FOR LOADING MATERIAL

Committee:—A. Kearney, chairman; R. E. Smith, Wm. Moir, W. F. Kiesel, L. H. Turner.

The committee reports it has no recommendations for changes in the present Rules for Loading Material to present to this convention, except to correct some errors, for the most part typographical, that were made in the last issue of the rules.

This conclusion has been reached as the result of the few subjects for change that have been presented during the current year, and more especially in order to give every one handling the rules more time and better opportunity to make up their minds what changes are really necessary.

First of all, we would direct your attention to Rule 26 of the 1910 Revision of the Rules for Loading Material.

In the 1910 issue Rule 26 provides for the exclusive use of metal spacing blocks. Probably everybody will recall the discussion of this point on the floor of the convention last year, and the action taken at that time, to eliminate that modification requiring metal blocks exclusively. It was decided then to continue the use of Rule 26 in its old form, that is, making the use of metal or wooden blocks optional.

It was a mistake allowing Rule 26 to go into the new issue of the rules in its modified form. The rule should read:

"The cars must be jacked apart by placing one jack on each side of the coupler, separating the cars until the couplers are pulled out to the fullest extent, inserting hardwood or metal blocks (latter preferred) to completely fill the space between the horns of coupler and end of sill, and coupler release-rod chain disconnected, as shown in Figs. 2 and 3."

Discussion.—The chairman stated that rule 6 was in conflict with A. R. A. rule 15, but believed that after further investigation the committee could alter it to make them harmonize without altering the principle.

Metal or wood spacing blocks were again under discussion, and a motion was passed eliminating the word "preferred" after the word "metal" in the rule, thus allowing either block to be used. Rule 121 was referred to letter ballot.

The report of the committe was accepted and referred to letter ballot.

CONCLUDING EXERCISES

While awaiting the report of the tellers on the election, the meeting was thrown open for general discussion on any subject and the matter of the present method of election was brought up by D. F. Crawford, who moved that the executive committee be authorized to appoint a committee with a view of simplyifying it and to transmit a circular report to the members before December 1, which should give the necessary changes in the constitution to be voted upon next year. This motion was carried.

Apprentices in the car shop was discussed, and a motion was carried to the effect that a special committee be appointed to report next year on this subject.

Following this a number of members spoke most strongly on the lateness of the reports this year, and every one, from members to the executive committee, except the secretary, was criticized. It appeared that the blame was not confined to any one point. A motion was finally carried that the appointment of the committee be issued to the members in circular form by the secretary as soon as they were appointed. In this way the members would know what subjects were to be investigated and to whom they might transmit information which came to their attention, and not have to await the receipt of a circular letter.

A motion was carried that the executive committee of the association extend to the executive committee of the American Railway Association a cordial invitation to visit the next convention individually, and the suggestion of the advisability of appointing a committee to visit the convention and make a report upon their observations.

[The reports and discussions on the following subjects will appear in the August issue: Train Pipe and Connection for Steam Heat; Refrigerator Cars; Prices for Labor and Material for Steel Cars; Train Lighting; Car Wheels: Test of Brake Shoes, Revision of Rules of Interchange and Consolidation.—Ed.]

A Flight of Stairs Has Been Erected in Paris over which 14,000,000 persons have passed without so much as scratching the surface. These steps are almost imperishable, for in the concrete of which they are constructed a generous proportion of carborundum has been introduced, and since carborundum is almost as hard as the diamond, it has given the concrete a wearing quality which no marble or granite could possibly approach.

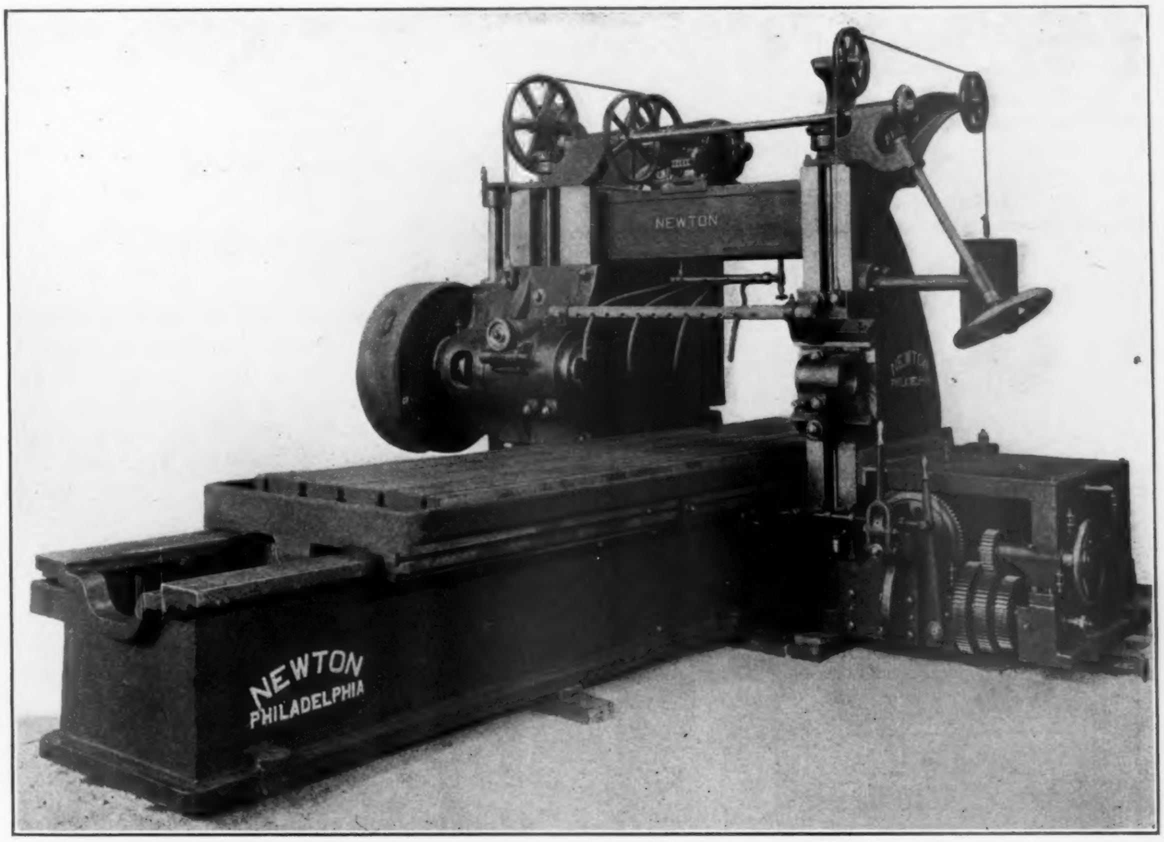
HIGHLY DEVELOPED HORIZONTAL MILLING MACHINE OF UNUSUAL PROPORTIONS

The type of machine herein illustrated has been attempted before, but it is believed that never before have such massive proportions and refinements been incorporated in any similar design. As this heavy 50 in. horizontal milling machine has been in operation but a short time, the Newton Machine Tool Works, of Philadelphia, Pa., have no data available concerning its output, but it is recalled that on their old design of nearly the same proportions and drive locomotive rods have been milled at a feed or table advance of about 8 in. per minute when taking cuts from 3/8 in. to 1/2 in. deep, and from 14 to 18 in. wide. In channeling two rods at one time, each channel 3 1/2 in. wide and 1 3/4 in. deep, the table advance, or feed, was 2 1/2 in. per minute.

From these two examples it will be noted that the rating of the machine by pounds of metal removed for a given time, or the number of cubic inches of metal removed, may be erroneous and very misleading, as the stress under which machines operate when taking very deep cuts is much greater than when taking slabbing cuts of even greater sectional area. The conclusion reached by the builders of this tool is that for ordinary slab milling the correct output of machines appears to be about one cubic inch of metal a minute per horsepower.

It is, of course, evident that such heavy duty must require an unusual combination of strength and rigidity, and a study of the design of this machine will clearly indicate that this has been attained in the very highest degree. This is particularly noticeable in the proportions and assemblage of the bed, uprights and cross-rail, which although of the ample stock necessary in machines of this desciption to withstand the severe strains to which they are subjected, have still been so pleasingly fashioned that the general appearance affords little indication of the total weight. Nevertheless the latter is 38,000 lbs. net and the floor space occupied is 21 by 15 ft., thus rendering the machine the largest of its type to be carried regularly as a stock product.

A study of the spindle, its drive and accompanying details is of interest as an indication of the care observed in the design to prevent the transmission of vibrations to the cut. The diameter of the spindle in parallel bearing is 7 in., in addition to which there is a double taper bearing in front of the spindle sleeve, the largest diameter of which is 11 in. The spindle sleeve is 13 1/2 in. in diameter and it has 10 in. of independent horizontal hand adjustments. The maximum distance between the spindle saddle and the outboard bearing is 51 in.; minimum distance center of spindle to top of work table, 5 in., and the maximum distance is 31 in. The spindle is arranged to drive a 4 in. diameter cutter arbor by means of a broad face key; it is fitted with a No. 7 Morse taper, and provided with a through retaining bolt to hold the arbors in place, thus relieving the outboard bearing of all strain when taking cuts.



HEAVY DESIGN 50-IN. HORIZONTAL MILLING MACHINE.

The drive is by a sleeve worm wheel 35 1/2 in. O. D., and it is transmitted by a double keyway. The worm wheel has a bronze ring with teeth of steep lead, and the driving worm is of hardened steel with roller thrust bearings, the latter being cast solid with the spindle saddle. It will be readily appreciated that through this general arrangement all stresses must be contained within the saddle and all vibration at the cut not merely minimized, but effectually eradicated. The drive to the spindle is further through bevel and spur gears connecting with the General Electric Company CLC 62 H.P. intermittent motor for 220 volts circuit, having a speed of 560 to 1,120 r. p. m., which gives a speed range to the spindle of 15.55 to 31.11 r. p. m.

The saddle, which has a bearing on the main upright 24 in. wide by 45 in. long, is counterweighted, and has square lock gibbed bearings on the upright, adjustments being made by taper shoes. The location of this taper shoe is of particular interest, as it is arranged to permit of easy detachment of the saddle should any accidents occur, and also to have the tension on the solid surface. The elevating screws for both the saddle and outboard bearing have a top and bottom bearing to permit of them being maintained in alignment at all times. The adjustment of the spindle sleeve is controlled by a worm and worm wheel, which governs the movement of the rack pinion

engaging into the spindle sleeve. The outboard bearing has an independent horizontal adjustment in its saddle of 8 in.

Among the refinements which have been incorporated in the new machine one which may be prominently mentioned is in connection with the vertical driving spline shaft. This shaft slides through bushings to which it is keyed, causing their rotaton in unison, thus lengthening the life of the bearing by preventing the escape of oil that would occur should the spline shaft rotate in the fixed bearings. The bevel driving gear on the vertical shaft is placed above the driving bevel gear on the horizontal shaft in order that the thrust on the bottom bearing may be equalized by the pressure of the gear and thus eliminate excessive wear on the thrust washers placed at the bottom of the shaft. In the pull pin feed gear bronze centers have been placed to facilitate renewals, if necessary, at a slight cost, and to overcome the objection of having a loose steel gear revolving on a steel shaft. The male friction clutch is fitted with apple wood blocks, thoroughly fitted, and held in place by bolts, a more adequate arrangement than in the former practice, which consisted of blocks and glue.

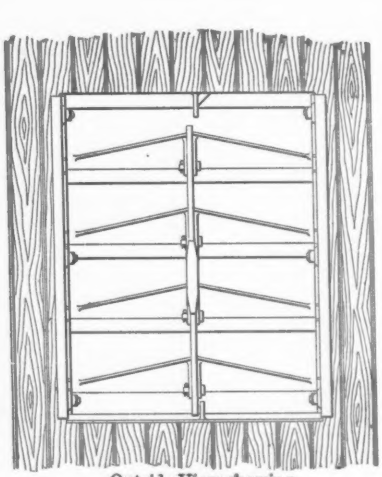
The feed is taken from the vertical driving shaft through to the operating side of the machine, where there are provided three changes of gear feed ranging from .10, .15 and .20 in. per revolution of the spindle, and there is also provided reversing power fast traverse by means of a friction clutch by engaging the double train of bevel friction clutch gears. One lever engages the clutch controlling the fast traverse of the table, and the direction of movement indicates the direction of travel to the table. Another lever engages the clutch for the transmission of feeds. One hand wheel, as shown, is for the hand movement of the table and the other for the simultaneous adjustment of the spindle saddle and the outboard bearing, which can also be elevated or lowered by means of the independent General Electric Company CQ 3 H. P. series wound 220 volt motor, having a speed of 1,425 r.p.m., which moves the saddle at 6 ft. per minute.

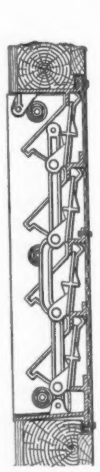
The work table of this machine is 42 in. wide, 14 ft. long, and entirely surrounded by an oil pan. The bed is 21 ft. long and 38 in. over the shear. All gears, with the exception of the worm wheel by which the fast traverse is obtained, are of hammered steel, with the teeth cut from the solid. The machine, viewed in entirety, represents a remarkable development in this extremely important tool, and one indeed which implies that little further could be done to enhance its intrinsic merit.

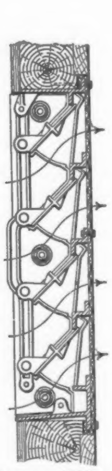
THE ALLEN CAR VENTILATOR

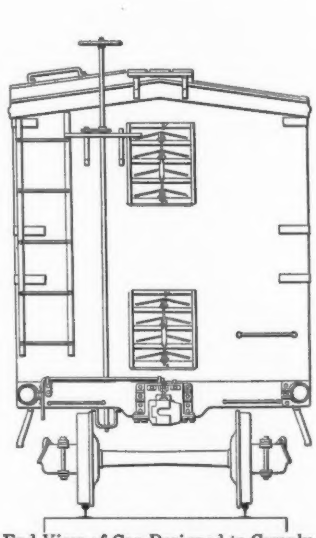
The ventilator now generally in use comprises a grating in the end of the freight car, with a wooden frame, vertical wrought iron rods and wire netting. This ventilator is closed by means of a wooden door sliding on a wrought iron track and secured in closed position by metal guides at the bottom of the door, and a set of ordinary door fasteners.

Certain recognized objections to this style of ventilator, such as high cost of maintenance, liability to damage from shifting loads, and interference of the door with the location of the


Outside View showing Ventilator Closed.


Sectional View showing Ventilator Closed.


Sectional View showing Ventilator Open.


End View of Car Designed to Comply with Recent Safety Appliance Law.

CONSTRUCTIVE DETAILS AND APPLICATION OF THE ALLEN CAR VENTILATOR

brake step, have resulted in an entirely new design of car ventilator which has been patented by G. L. Allen, chief draftsman of the Atlanta Coast Line, and is now being applied to 1,400 cars in course of construction for that system by the American Car and Foundry Company.

The Allan ventilator, as shown in the accompanying drawing, is very simple in construction, and is composed throughout of malleable iron. In general appearance it is extremely neat, being contained practically within the thickness of the end wall of the car, and occupying a space therein of only about two feet. The essential features of the ventilator are: a main frame having flanges inside of the car on all four sides; "Z"-shaped horizontal bars cast integral with the frame which lap over the top of the movable plates, strengthen the frame transversely and back up the wire netting and movable plates, pivotally connected at the middle by an operating rod. The movable plates are not hinged or pivoted to the frame, but merely rest at their ends in recesses in the sides of the frame. The ventilator is held in an open or closed position by gravity, and needs only to be pulled open or pushed closed, by in each case exerting a slight lifting force on the handle. The holes which are shown in the ends of the operating rod, with corresponding holes in the lugs at the top and bottom of the frame, are provided simply for "sealing."

The movable plates, when in open position, stand at an angle of 45 degrees, their long edges in line with the upper edges of the Z-bars below them, thus making it necessary for rain to be driven upward in order to enter the ventilator. The latter is therefore practically rain proof whether open or closed and the slanting plates also tend to deflect sparks. The ease with which the ventilator can be operated makes it possible for train men to manipulate them while the train is in motion. This is an advantage in the case of through trains where the trainmen may pass from one car to another and from the running board or roof of an adjoining car, and open or close the ventilator by means of a rod with a hooked end. The netting is applied on the inside as usual, being crimped over the ventilator flanges on

all four edges and held securely in place by nails or bolts through the flanges and netting.

The Allen ventilator does not interfere with any form of end bracing, whether horizontal or vertical, and being constructed of metal throughout is well adapted for use on cars of all-steel or composite design.

NUT LOCKS VS. DOUBLE NUTTING AND IMPROVEMENTS IN NUT LOCKING PRACTICE

The Jones Positive Nut Lock in the three principal forms in which it is manufactured, is one of the oldest plate form of nut lock on the market. The present owners, who purchased the Jones interests some years ago, made several improvements in

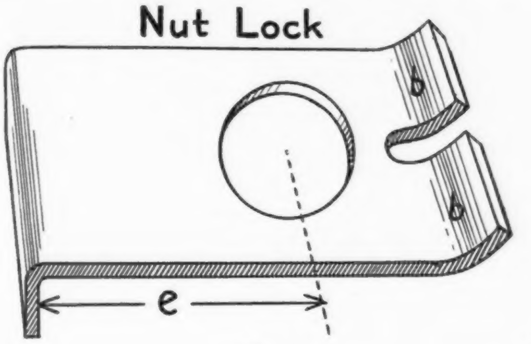


FIG. 1.

the construction of the device, principal among which is the band across the two flanges or slotted end of the arch bar style nut lock as designated by letters "b b" in Figure 1.

This band, made in the process of manufacture, does not interfere with the free sweep of the nut when it is being tightened up, and materially facilitates the application of this device by making it easy to drive one, or both, of the lips "b b" down against the side of the nut with a hammer and without the use of a chisel or special tool.

Another improvement made in connection with the arch bar style is the simple device for fastening column and journal bolts, to lock them and prevent them from backing out of the nuts. This device is manufactured with a flange at each end; one flange to extend down the edge of the arch bar and another flange at the other end to bear against the bolt head. These two flanges at right angles with the body of the fastener, both being made in the process of manufacture, render it unnecessary to do any driving or forming in applying this device other than would be necessary in applying a common wrought washer. This device saves much labor and is meeting with popular favor.

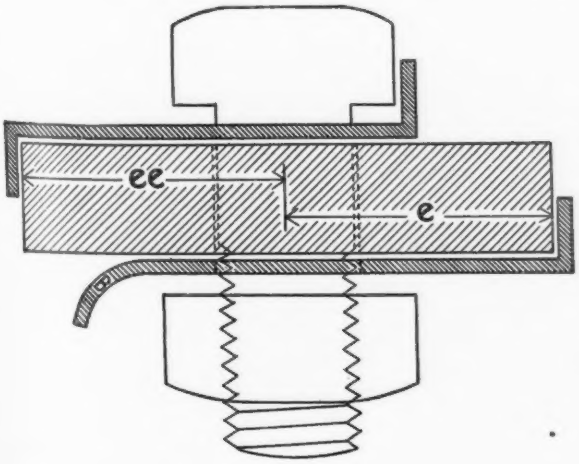


FIG. 2.

Figure 2 shows the application of both the bolt fastener and arch bar style nut lock above mentioned.

The original form of Jones spur nut lock for use on wood surfaces, was made with four beveled spurs, which caused the lock to adhere to the wood securely, even in case of shrinkage. This original form is, however, being gradually superseded by

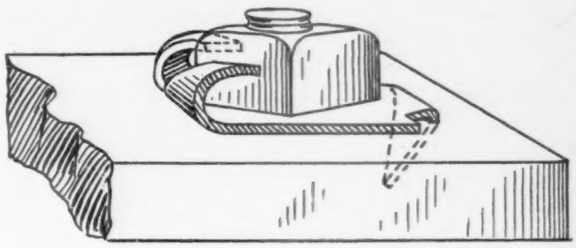


FIG. 3.

the improved form of spur nut lock in the form as shown in Figure 3, which latter form has but one spur or tang to engage the wood surface, which single spur is so located as to come sufficiently within the sweep of the nut to be readily forced into the wood by the ordinary application of the nut without distorting the nut lock. This improved form of spur nut lock is made of much heavier and much wider material than the original form, it having bearing proportions sufficient to afford the nut ample resistance against being drawn into the wood, the same as the recognized proportions of a common wrought washer.

The Jones Two Hole Nut Lock, which has been extensively used on draftrigging bolts, cylinder-block bolts and similar bolts located uniformly a certain distance apart and in other cases where it is inconvenient to extend the nut lock over an angle to secure its bearing is another form of their device which has been improved upon by the circular bend across the two flanges, or slotted end, made in the process of manufacture, as shown in Figure 4, which bend turns down the ends far enough to per-

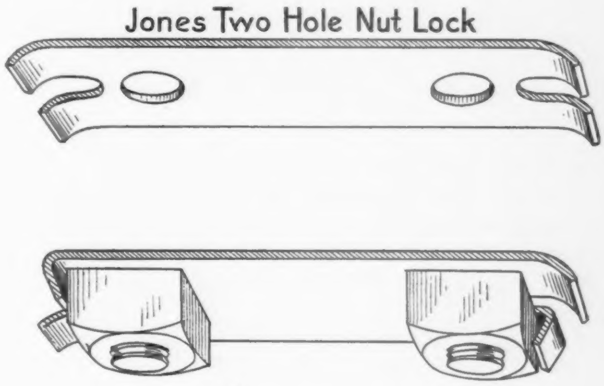


FIG. 4.

mit driving them against the side of the nut with a hammer and without the use of a special tool.

Regarding the long established practice of double nutting on many bolts, journal and column bolts particularly, attention is called to the effect produced by the use of a double nut, or jam nut. The use of a single nut applied in the ordinary way brings nut pressure on the upper side, or backside, of the bolt thread, as indicated by letter "B" in Fig. 5. Assuming the first nut to be applied in a proper manner, the bearing of such nut would be against the upper or backside of bolt threads, the same as in previous illustration. However, when jam nut is applied such jam nut in order to be effective must be screwed up with considerable tension against the first nut. As the amount of tension against the under nut depends entirely upon the intelligence of the operative applying it, and no fixed rule is known for correctly measuring such tension and determining the proper amount, depending upon "feel" is perforce guesswork.

If too much tension is exerted on the under nut "N" by screwing the jam nut "J" against it tighter than is necessary to produce the simple locking effect desired, the result is an undue strain or reverse bearing "RB" by the first nut "N" against the bolt threads. In any event, after the best possible application of

a jam nut, the jam nut carries all the load pressure, together with locking strain and the under nut "N" no longer carries any of the load "W," but becomes essentially the same as one of a

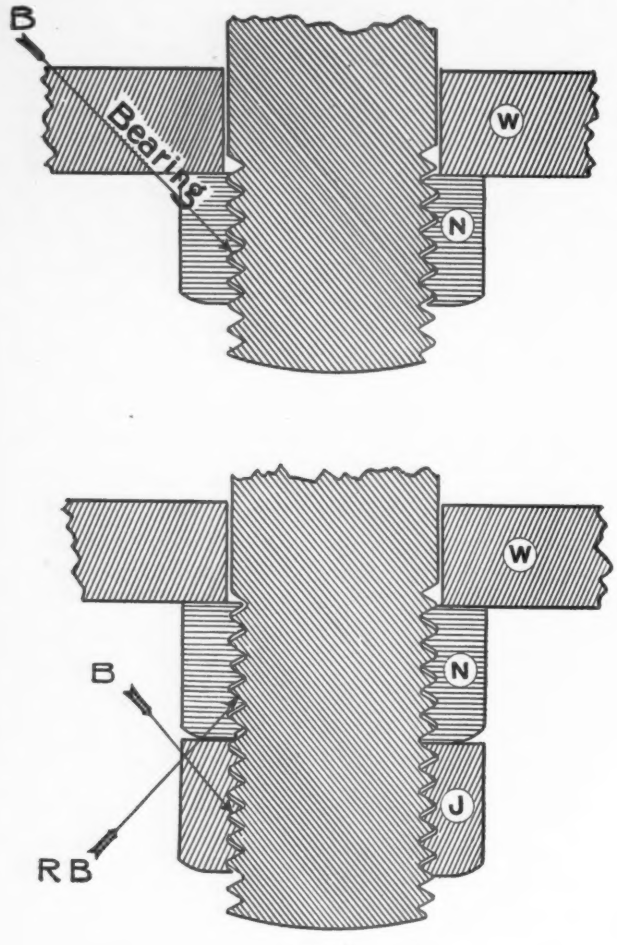


FIG. 5.

number of assembled parts held together by nut pressure, except in so far as its reverse pressure may have established a locking effect upon the outer nut or jam nut "J."

These improvements are used on all the nut locks manufactured by the present owners, the Jones Positive Nut Lock Company, Chicago, Ill.

OPEN SIDE PLANER OF MASSIVE DESIGN

The machine illustrated in the accompanying photograph was recently furnished the Pennsylvania Steel Company by the Cleveland Planer Works, of Cleveland, O., and is a very interesting example of what can be obtained through the combination of great strength and rigidity with extreme simplicity and ease of manipulation.

The machine, which is the builders' standard type parallel drive 60 in. by 60 in. by 22 ft., and equipped for motor installation, is of box section design throughout, in bed, column and cross rail. The bed is cast closed on top, with but one opening sufficient only to admit of the removal of the bull gear. It is ribbed vertically at intervals of about 36 inches for its entire length. The column base is cast integral with the bed, with the bottom cast closed in the column base and the section of the bed directly opposite to it, thus lending materially to the stiffness of the tool. The column is double ribbed vertically on the inside, and of extremely heavy pattern, with a broad bearing on its face, giving ample support to the knee, and is broader than the planing width of the machine. The table is of very heavy pattern, with 5 planed "T" slots, and on each side of every slot is a row of holes, not bored through the table, thus making it impossible for chips to work down to the top of the bed, and thus reducing the liability of injury to the bull gear to a minimum.

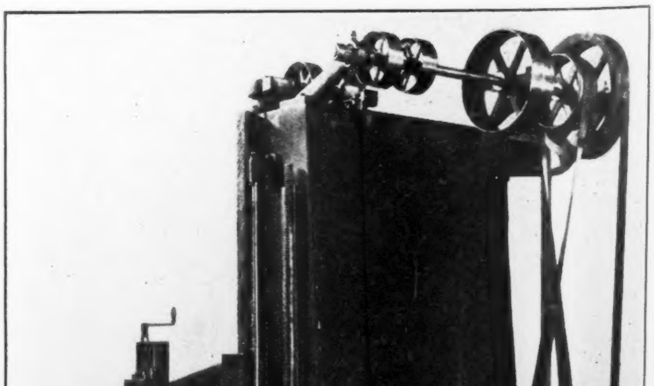
The most important feature in the construction of this machine is its extreme simplicity, as will be readily seen by the illustration, and particularly that there is almost an entire absence of connecting links and arms. All gearing and running shafts can be removed from the sides of this machine without disturbing in any way the column or knee, a feature which will be readily appreciated by mechanics in general. All gears in the drive with the exception of the full gear and its pinion are enclosed and run in oil, making it impossible for chips to damage the working parts.

Both heads are taper gibbed and of ample proportion to insure extreme rigidity to the cut. The heavy bearings are of bronze pressed into bosses cast integral with the bed, thus making it possible to replace these at any time when it might be necessary on account of wear, without changing in any way the alignment of the machine. The feeds are operated by the common type of friction box and are capable of very easy and quick adjustment.

The countershaft, as will be noted, is mounted upon the top of the column and is very firmly supported by three heavy arms, thus giving it necessary rigidity to insure smooth running. The arrangement for supporting the motor is very simple, but effective, as by lowering the entire motor bracket by the adjusting screw immediately beneath, the driving belt from the motor to the countershaft can always be kept at exactly the right working tension.

The approximate weight of this planer is 70,000 pounds, from which it may be judged to be a very substantial and solid tool.

THE UNIVERSITY OF ILLINOIS will receive from the Legislature, recently adjourned, for its support for the two years following July 1, 1911, the sum of $3,500,000. Something more than a half million dollars of this amount is for buildings. The College of Engineering, the success of which interests many of our readers, received specific appropriations for maintenance amounting to $192,000, and for a building $200,000. In addition to this the Department of Mining Engineering received an appropriation for maintenance amounting to $35,000, and for equipment $25,000.



THE CLEVELAND GAP PLANER.

The Legislature in providing for the future support of the University has authorized a one mill tax upon the assessed value of the State.

PERSONALS

C. C. FRALICH has been appointed assistant master mechanic of the Ann Arbor Railroad, with office at Owosso, Mich.

J. E. MEHANEY has been appointed general storekeeper of the First district of the Oregon-Washington Railroad & Navigation Co., with office at Portland, Ore.

C. W. DOWNS, general foreman of the Chicago, Terre Haute & Southeastern R. R. at Terre Haute, Ind., has been transferred to Bedford, with the same company.

T. H. CURTIS, superintendent of machinery of Louisville and Nashville Ry. for the last eight years, has resigned, and will leave railroad work to engage in private business.

C. H. RAE, general master mechanic of the Louisville & Nashville Ry., at Louisville, Ky., has been appointed assistant superintendent of machinery, succeeding Charles F. Giles, promoted.

J. E. OSMER, assistant master mechanic of the Chicago and North Western Ry. at Boone, Iowa, has been appointed master mechanic of the newly created West Iowa division, with office at Boone.

W. A. STEARNS, mechanical engineer of the Louisville & Nashville Ry., at Louisville, Ky., has resigned to become assistant to the chief mechanical engineer of the American Steel Foundries, at St. Louis, Mo.

A. W. MUNSTER has been appointed engineer of tests of the New York, New Haven and Hartford R. R., with office in the South Terminal Station, Boston, Mass., succeeding B. S. Hinchley, transferred to other duties.

A. W. GIBBS, general superintendent of motive power of Pennsylvania Railroad lines east of Pittsburg, has been appointed chief mechanical engineer, succeeding to the duties of T. N. Ely, former chief of motive power, who retired from active service July 1.

R. N. DURBOROW, superintendent of motive power of the Eastern Pennsylvania division of the Pennsylvania Railroad, at Altoona, Pa., has been appointed general superintendent of motive power of lines east of Pittsburg and Erie.

ROBERT K. READING, superintendent of motive power of the Buffalo and Allegheney Valley division of the Pennsylvania Railroad, at Buffalo, N. Y., succeeds R. N. Durborow, and William Eliner, Jr., master mechanic of the Pittsburg division, succeeds Mr. Reading.

B. S. HINCHLEY, formerly engineer of tests, New York, New Haven and Hartford R. R., has been appointed purchasing agent, with office in the North Station, Boston, Mass., succeeding C. N. Chevalier, who retired from active service July 1.

F. S. RODGER general car and locomotive foreman of the Chicago, Milwaukee & St. Paul Ry. at Marion, Iowa, has been appointed assistant district master mechanic of the Superior division, with office at Green Bay, Wis., succeeding E. Z. Hermansader, promoted.

C. H. HEDGCOCK, chief clerk in the mechanical department of the Louisville & Nashville Ry., at Louisville, Ky., has been appointed assistant superintendent of machinery of that company, the organization now including two assistant superintendents in the mechanical department.

W. H. BRADLEY, formerly master mechanic of the Iowa division of the Chicago & North Western Ry. at Clinton, Iowa, has been appointed master mechanic of the East Iowa division, with office at Clinton, Iowa. This change is incidental to the dividing of the Iowa division into the East Iowa and West Iowa divisions.

CHARLES F. GILES, assistant superintendent of machinery of the Louisville & Nashville Ry., at Louisville, Ky., has been appointed superintendent of machinery, succeeding T. H. Curtis, resigned. Mr. Giles was born at Rowlesburg, W. Va., November 2, 1856, and entered railway service as an apprentice in the shops of the Baltimore & Ohio R. R. at Wheeling in 1873, and in the shops of that road, the Texas & Pacific Ry., the Pennsylvania R. R., and the Louisville & Nashville Ry. he remained until 1882, in which year he was made foreman on the L. & N. In 1887 he was promoted to the position of master mechanic, at Birmingham; the next year to a similar position at Pensacola, and on October 1, 1902, became master mechanic at the main shops of the company at Louisville. He was appointed assistant superintendent of machinery on February 1, 1904.

CATALOGS

BEARING METAL.—The quarterly number of "The Graphose Age," published by the Chicago Bearing Metal Co., of Chicago, Ill., has appeared with its usual attractiveness, and in addition to its medley of good humor is not lacking in some plain truths concerning the good service which may be expected from the Graphose bronze locomotive bearings. This issue is well worth reading.

MACHINE TOOLS.—Descriptive of their exhibit at the Atlantic City Conventions, Manning, Maxwell & Moore, Inc., issued a very attractive catalog in which was illustrated the line of machines which were in operation, and of which practical demonstrations were given. These included a working exhibit of "National" bolt and nut machinery, showing the latest direct motor driven designs, including a National wedge grip bolt header; a new National semi-automatic nut tapper; a National quadruple bolt cutter and a National die sharpener.

LEATHER BELTING.—The June issue of "The Phoenix," published by the New York Leather Belting Co., at 51 Beekman St., New York, in addition to its regular monthly instructive and well presented matter on the general subject of belting, mentions the addition of two more companies to the selling family. These are the Carlton Hardware Company, of Calumet, Mich., and the Equipment Company, of Kansas City, Mo., who recently absorbed certain branches of the business of the Mercantile Lumber & Supply Co. of that city.

VALVE GEARS.—The Pilliod Brothers Company, of Toledo, O., has issued a new catalog descriptive of its "crosshead connection" valve gear, which is fast winning recognition as a thoroughly practical and simplified method of valve control. The catalog, in addition to a thorough analysis of the motion, contains half tones showing its application to a locomotive of the Duluth, Toledo and Ironton Ry. and to one of the Delaware and Hudson Company. The subject in general is timely and the catalog should be carefully perused by those interested.

MACHINE TOOLS.—The Gisholt Machine Co., of Madison, Wis., has issued an interesting historical leaflet in which an explanation is given regarding the name and in brief some of the early history of the company, which was founded nearly twenty-five years ago by John A. Johnson, of Madison, Wis. The leaflet contains a half tone illustration of C. O. Johnson, president and general manager, and H. S. Johnson, vice-president and works manager, posed in their working clothes. A cut of the first plant is also shown, which served until more room was necessary, when removal was made to the present shop. The latter is now in turn very inadequate in size, and is in process of expansion to properly care for the large and constantly growing business.

BALL BEARINGS.—The employment of ball bearings in wood working machinery, and in our and feed milling machinery, is described and illustrated by the Hess-Bright Mfg. Co., of Philadelphia, Pa., in recently published catalogs which treat on the two applications most comprehensively. Particularly in connection with woodworking machinery the descriptive matter is of much interest. The ordinary causes of heating are pointed out, attention called to the liability to fire, and the methods explained through which they may be prevented. It is pointed out that these ball bearings as applied to flour and feed milling machinery reduce by one-third to one-half the power required to drive the mill, and a corresponding reduction may be made in the width or extension of the belt, and a material saving in belting renewals effected.

NOTES

STANDARD RAILWAY EQUIPMENT CO.—This company of St. Louis, Mo., has moved its general office to the Frick Building, Pittsburgh, Pa.

AMERICAN LOCOMOTIVE CO.—W. T. Rupert has been sent by this company to Japan to superintend the setting up of several locomotives recently shipped to that country.

BETTENDORF AXLE CO.—W. P. Bettendorf, president of this company, of Bettendorf, Iowa, died at his home in the latter city, Friday, June 3. Mr. Bettendorf was born in Mendota, Ill., July 1, 1857. He was the eldest of four children.

WESTINGHOUSE ELECTRIC & MFG. CO.—The New York, New Haven and Hartford R. R. Co. has placed an order with the above company for fourteen articulated-truck switching locomotives. Each locomotive is to be equipped with a quadruple equipment of No. 410 motors and type H. B. Unit Switch control.

RALSTON STEEL CAR CO.—This company of Columbus, O., has recently opened an office in the Henry W. Oliver Building, room 2438, Pittsburgh, Pa. This office is in charge of C. S. Rea, who represents the Ralston Steel Car Co. in the Pittsburgh district. Prior to the opening of this office Mr. Rea was temporarily at room 604 of the same building.

BROWN HOISTING MACHINERY CO.—Harvey H. Brown has been elected president of this company of Cleveland, O., succeeding his brother, the late Alexander E. Brown, founder of the company, who died April 26. Other officers were elected as follows: Alexander C. Brown, director and vice-president; George C. Wing, secretary; Charles T. Pratt, treasurer, and Richard B. Sheridan, general manager.

HOMESTEAD VALVE MFG. CO.—Announcement has been made by this company of Pittsburgh, Pa., that Frederick K. Blanchard, 422 River St., Troy, N. Y., will represent the firm in the cities of Albany and Troy, N. Y., and vicinity. Mr. Blanchard will have quite a stock of Homestead Valves on hand at all times and will be prepared to supply the engineer and power plants of those cities with Homestead Valves on short notice.

EXHIBITORS AT ATLANTIC CITY

Acme Supply Co., Chicago, Ill.
Adams & Westlake Co., Chicago, Ill.
Ajax Mfg. Co., The, Cleveland, O.
American Arch Co., New York, N. Y.
American Balance Valve Co., Jersey Shore, Pa.
American Brake Co., St. Louis, Mo.
American Brake Shoe & Fdy. Co., Mahwah, N. J.
American Car & Fdy. Co., New York, St. Louis and Chicago.
American Locomotive Co., New York, N. Y.
American Mason Safety Tread Co., Boston, Mass.
American Nut & Bolt Fastener Co., Pittsburgh, Pa.
American Radiator Co., Chicago, Ill.
American Steel Foundries Co., Chicago, Ill.
American Tool Works Co., Cincinnati, O.
American Vanadium Co., Pittsburgh, Pa.
Anchor Packing Co., Philadelphia, Pa.
Armstrong-Blum Mfg. Co., Chicago, Ill.
Armstrong Bros., Tool Co., Chicago, Ill.
Atlas Car & Mfg. Co., Cleveland, O.
Automatic Ventilator Co., New York, N. Y.

Baldwin Locomotive Works, Philadelphia, Pa.
Berry Bros., Ltd., Detroit, Mich.
Besly & Company, Charles H., Chicago, Ill.
Bettendorf Axle Co., Bettendorf, Ia.
Bird & Co., J. A. & W., Boston, Mass.
Bowser & Co., Inc., S. F., Ft. Wayne, Ind.
Buckeye Steel Castings Co., Columbus, O.
Buffalo Brake Beam Co., New York, N. Y.
Bullard Machine Tool Co., Bridgeport, Conn.
Burroughs Adding Machine Co., Detroit, Mich.
Buyers' Index Co., Chicago, Ill.

Camel Co., Chicago, Ill.
Carborundum Co., The, Niagara Falls, N. Y.
Carey Company, Philip, Cincinnati, O.
Carnegie Steel Co., Pittsburgh, Pa.
Carter Iron Co., Pittsburgh, Pa.
Chase & Co., L. C., Boston, Mass.
Chicago Car Heating Co., Chicago, Ill.
Chicago Pneumatic Tool Co., Chicago, Ill.
Chicago Railway Equipment Co., Chicago, Ill.
Chicago Steel Car Co., Chicago, Ill.
Chicago Varnish Co., Chicago, Ill.
Chisholm & Moore Mfg. Co., The, Cleveland, O.
Cleveland Twist Drill Co., Cleveland, O.
Cochrane-Bly Co., Rochester, N. Y.
Coe Brass Mfg. Co., Ansonia, Conn.
Coe Mfg. Co., W. H., Providence, R. I.
Colonial Steel Co., Pittsburgh, Pa.
Commercial Acetylene Co., The, New York, N. Y.
Commonwealth Steel Co., St. Louis, Mo.
Consolidated Car Heating Co., Albany, N. Y.
Cooper-Hewitt Electric Co., Hoboken, N. J.
Crane Co., Chicago, Ill.
Crosby Steam Gage & Valve Co., Boston, Mass.
Crucible Steel Co. of America, Pittsburgh, Pa.
Curtain Supply Co., Chicago, Ill.

Dahlstrom Metallic Door Co., Jamestown, N. Y.
Damascus Brake Beam Co., The, Cleveland, O.
Davis-Bounonville Co., New York, N. Y.
Davis Solid Truss Brake Beam Co., Wilmington, Del.
Dearborn Drug & Chemical Works, Chicago, Ill.
Detroit Hoist & Machine Co., Detroit, Mich.
Detroit Lubricator Co., Detroit, Mich.
Dickinson, Inc., Paul, Chicago, Ill.
Dixon Crucible Co., Joseph, Jersey City, N. J.
Dressel Railway Lamp Works, The, New York, N. Y.
Duff Mfg. Co., The, Pittsburgh, Pa.
Dublin Automatic Safety Car Coupler Co., of Canada, Ltd., Sarnia, Ont.

Eagle Glass & Mfg. Co.,
Edison Storage Battery Co., Orange, N. J.
Edwards Company, The O. M., Syracuse, N. Y.
Electric Controller & Mfg. Co., Cleveland, O.
Electric Storage Battery Co., Philadelphia, Pa.
Emery Pneumatic Lubricator Co., St. Louis, Mo.
Enterprise Railway Equipment Co., Chicago, Ill.

Faessler Mfg. Co., J., Moberly, Mo.
Fairbanks, Morse & Co., Chicago, Ill.
Flannery Bolt Co., Pittsburgh, Pa.
Flower Waste & Packing Co., New York, N. Y.
Ford & Johnson Co., The, Michigan City, Ind.
Forsythe Brothers Co., Chicago, Ill.
Fort Pitt Iron Works, Pittsburgh, Pa.
Foster Co., The Walter H., New York, N. Y.
Franklin Mfg. Co., The, Franklin, Pa.
Franklin Railway Supply Co., New York, N. Y.
Frost Railway Supply Co., The, Detroit, Mich.

Galena Signal Oil Co., Franklin, Pa.
Garlock Packing Co., Palmyra, N. Y.
General Electric Co., Schenectady, N. Y.
General Railway Supply Co., Chicago, Ill.
Gold Car Heating & Lighting Co., New York, N. Y.
Goldschmidt Thermit Co., New York, N. Y.
Gould Coupler Co., New York, N. Y.
Greene, Tweed & Co., New York, N. Y.
Greenlaw Mfg. Co., Boston, Mass.
Grip Nut Co., Chicago, Ill.

Hale & Kilburn Mfg. Co., Philadelphia, Pa.
Hammett, H. G. Troy, N. Y.
Harrington, Son & Co., Inc., Edwin, Philadelphia, Pa.
Hewitt, H. H., New York, N. Y.
Hobart-Allfree Co., Chicago, Ill.
Home Rubber Co., Trenton, N. J.
Hunt Co., C. W., New York, N. Y.
Hunt-Spiller Mfg. Co., South Boston, Mass.
Hutchins Car Roofing Co., Detroit, Mich.
Illinois Steel Co., Chicago, Ill.
Independent Pneumatic Tool Co., Chicago, Ill.
Industrial Supply & Equipment Co., Chicago, Ill.
International Correspondence Schools, Scranton, Pa.
Jacobs-Schupert U. S. Fire Box Co., Coatesville, Pa.
Jenkins Bros., New York, N. Y.
Jessop & Sons, Inc., New York, N. Y.

Johns-Manville Co., H. W., New York, N. Y.
Joliet Railway Supply Co., Joliet, Ill.
Jones & Laughlin Steel Co., Pittsburgh, Pa.
Joyce, Cridland Co., The, Dayton, O.

Kennicott Co., The, Chicago, Ill.
Kerite Insulated Wire & Cable Co., New York, N. Y.
Keystone Drop Forge Works, Chester, Pa.
King Fifth Wheel Co., Philadelphia, Pa.
Kirby Equipment Co., Chicago, Ill.
Knight Pneumatic Sander Co., Huntington, Ind.

Landis Machine Co., Waynesboro, Pa.
Landis Tool Co., Waynesboro, Pa.
Linde Air Products Co., Buffalo, N. Y.
Locomotive Improvement Co., The, Clinton, Ia.
Locomotive Superheater Co., New York, N. Y.
Lucas Machine Tool Co., Cleveland, O.
Lunkenheimer Co., The, Cincinnati, O.
Lupton's Sons Co., David, Philadelphia, Pa.

McClellon, J. M., Boston, Mass.
McConway & Torley Co., The, Pittsburgh, Pa.
McCord & Co., Chicago, Ill.
Main Belting Co., Philadelphia, Pa.
Manning, Maxwell & Moore, Inc., New York, N. Y.
Massachusetts Mohair Plush Co., Boston, Mass.
Matthews-Davis Tool Co., St. Louis, Mo.
Michigan Lubricator Co., Detroit, Mich.
Midvale Steel Co., Philadelphia, Pa.
Mid-Western Car Supply Co., Chicago, Ill.
Milburn Co., Alexander, Baltimore, Md.
Moore & Co., Benjamin, Brooklyn, N. Y.
Moran Flexible Steam Joint Co., Louisville, Ky.
Mudge & Co., Burton W., Chicago, Ill.

Nathan Mfg. Co., New York, N. Y.
National Lock Washer Co., Newark, N. J.
National Malleable Casting Co., Cleveland, O.
National Tube Co., Pittsburgh, Pa.
Nelson Valve Co., Philadelphia, Pa.
Newhall Engineering Co., George M., Philadelphia, Pa.
New York Air Brake Co., New York, N. Y.
Nickel-Chrome Chilled Car Wheel Co., Pittsburgh, Pa.
Niles-Bement-Pond Co., New York, N. Y.
Norton, Inc., A. O., Boston, Mass.

Pantasote Co., New York, N. Y.
Parker Car Heating Co., Ltd., London, Ontario.
Parkesburg Iron Co., Parkesburg, Pa.
Parsons Engineering Co., Wilmington, Del.
Pennsylvania Flexible Metallic Tubing Co., Cleveland, O.
Pilliod Brothers, Toledo, O.
Pilliod Company, New York, N. Y.
Pittsburgh Equipment Co., Pittsburgh, Pa.
Pneumatic Jack Co., Inc., Louisville, Ky.
Post & Co., Inc., E. L., New York, N. Y.
Pressed Steel Car Co., Pittsburgh, Pa.
Pyle-National Electric Headlight Co., Chicago, Ill.
Pyrene Mfg. Co., New York, N. Y.

Railway Materials Co., Chicago, Ill.
Ralston Steel Car Co., Columbus, O.
Remington Typewriter Co., New York, N. Y.
Restein Co., Clement, Philadelphia, Pa.
Rock Island Mfg. Co., Rock Island, Ill.
Rockwell Furnace Co., New York, N. Y.
Royersford Foundry & Machine Co., Inc., Royersford, Pa.
Rubberset Company, Newark, N. J.

Safety Car Heating & Ltg. Co., New York, N. Y.
Scarritt-Comstock Furniture Co., St. Louis, Mo.
Scullin-Gallagher Iron & Steel Co., St. Louis, Mo.
Sellers & Co., Inc., William, Philadelphia, Pa.
Sherwin-Williams Company, Cleveland, O.
Simplex Railway Apppliance Co., New York, N. Y.
Sipe & Company, James B., Pittsburgh, Pa.
Smith Premier Typewriter Co., Syracuse, N. Y.
Sprague Electric Works of General Electric Co., New York.
Standard Coupler Co., New York, N. Y.
Standard Steel Car Co., New York, N. Y.
Standard Steel Works Co., Philadelphia, Pa.
Storrs Mica Co., Owego, N. Y.
Street, Clement F., Schenectady, N. Y.
Strong, Carlisle, Hammond Co., Cleveland, O.
Summers Steel Car Co., Pittsburgh, Pa.
Symington Co., The T. H., Baltimore, Md.
Templeton, Kenly & Co., Ltd., Chicago, Ill.
Topping Bros., New York, N. Y.
Trill Indicator Co., Corry, Pa.
Tyler Co., The W. S., Cleveland, O.

Underwood & Co., H. B., Philadelphia, Pa.
Union Draft Gear Co., Chicago, Ill.
Union Fibre Co., Winona, Minn.
Union Mfg. Co., New Britain, Conn.
Union Spring & Mfg. Co., Pittsburgh, Pa.
United Engineering & Foundry Co., Pittsburgh, Pa.
United States Light & Heating Co., New York, N. Y.
U. S. Metal & Mfg. Co., New York, N. Y.
U. S. Metallic Packing Co. Philadelphia, Pa.
United States Radiator Corporation, Detroit, Mich.
Universal Safety Tread Co., Boston, Mass.

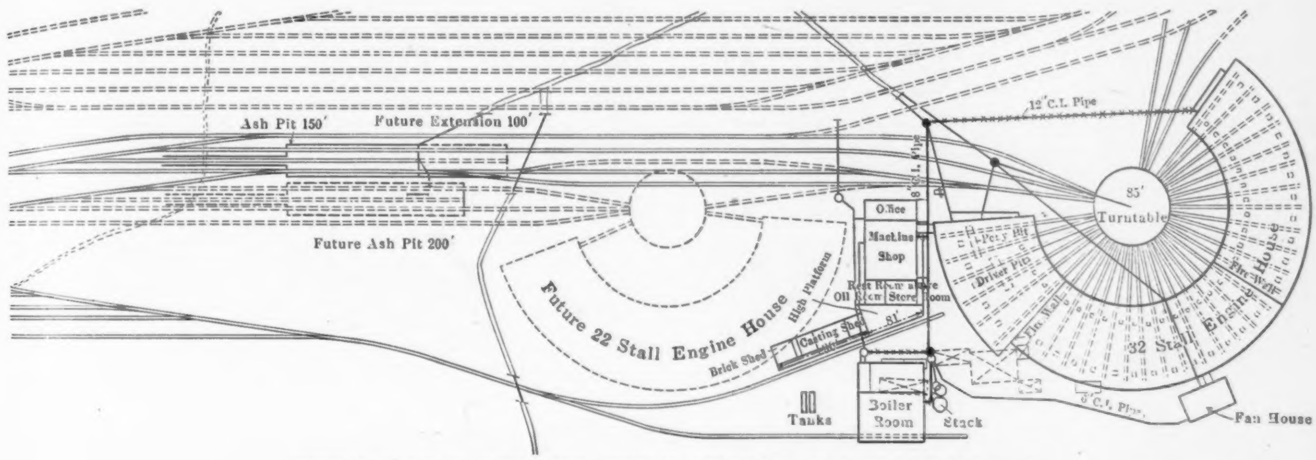
Van Dorn & Dutton Co., Cleveland, O.
Van Dyck Churchill Co., New York, N. Y.

Ward Equipment Co. New York N. Y.
Warner & Swasey Co., Cleveland, O.
Welsbach Company, Gloucester, N. J.
West Disinfecting Co., New York, N. Y.
Western Railway Equipment Co. St. Louis Mo.
Western Steel Car & Fdy. Co., Hegewisch, Ill.
Western Wheeled Scraper Co., Aurora, Ill.
Westinghouse Air Brake Co., Pittsburgh, Pa.
Westinghouse, Church, Kerr & Co., New York, N. Y.
Westinghouse Electric & Mfg. Co., Pittsburgh, Pa.
Westinghouse Lamp Co., Bloomfield, N. J.
Westinghouse Machine Co., East Pittsburgh, Pa.
Wheel Truing Brake Shoe Co., Detroit, Mich.
Williams All Service Car Door Co., Clinton, Ill.
Wilson Remover Co., New York, N. Y.
Wood, Guilford S., Chicago, Ill.
Wood Locomotive Fire Box & Tube Plate Co., The William H., Media, Pa.
Yale & Towne Mfg. Co., New York, N. Y.
Zug Iron & Steel Co., Pittsburgh, Pa.

Locomotive Terminal at New Durham, N. J.

THE NEW ROUNDHOUSE AND BUILDINGS RECENTLY ERECTED AT THIS POINT BY THE NEW YORK CENTRAL AND HUDSON RIVER RAILROAD CONSTITUTE A FINE EXAMPLE OF A MODERN LOCOMOTIVE TERMINAL, DESIGNED WITH THE END IN VIEW TO PROVIDE FOR THE REQUIREMENTS OF THE FUTURE

In keeping with its policy to rehabilitate on distinctively modern lines existing locomotive terminals included in the system, or, where such rehabilitation is impossible or considered inadvisable, to provide an entirely new plant, the New York Central and Hudson River Railroad has recently abandoned the old West Shore roundhouse with its accompanying layout at New Durham, N. J., and erected in that vicinity a new terminal largely in accordance with its established standards as exemplified at other points on its lines. The latter is adequate and well-appointed in every detail, and in addition it has been very wisely planned to meet the inevitable expansion of business on this part shop, store room, oil house, engineers' rest room and office building, and a power house containing the boiler wash-out system and air compressors. The entire arrangement, as will be noted in the accompanying general plan, is remarkably compact. The usual severity of the winters in this section has been apparently borne prominently in mind in the grouping of the various structures, as it is possible for the foremen and workmen to move largely under cover throughout the principal buildings. An additional advantage also obtained through this disposition is a material shortening of all pipe lines from the power house, to a far less extent in fact than may be observed in connection with



GENERAL PLAN OF NEW YORK CENTRAL TERMINAL AT NEW DURHAM, N. J.

of the system in the future, without the acquisition of additional property, and without change in the existing buildings which at present comprise the new plant.

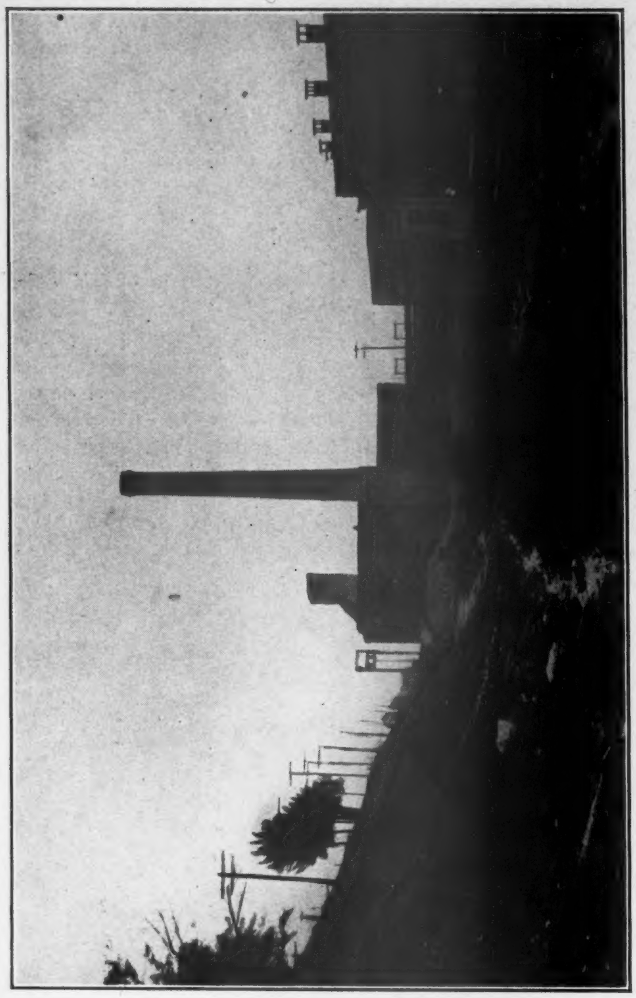
The old terminal at New Durham proper constituted the shops of the West Shore Railroad at the time of its acquisition by the New York Central, and for several years had been considered unsuitable to meet the demands imposed by the metamorphosis in locomotive design which has been the feature of the last decade or so. The shop buildings and the roundhouse are largely of frame construction, and the latter would not accommodate modern power to the extent of allowing it to be worked on effectively. A move to more suitable quarters would no doubt have been effected long since had it been possible to secure the proper site, where the building operations might be economically conducted, and the necessary property acquired without a prohibitive initial expenditure.

The location finally determined upon is about one mile north of the original shops, or midway between New Durham and Babbitt, at a point where the wide expanse of the Hackensack meadows on the west begins a rather abrupt upward slope towards the Palisades of the Hudson River on the east. Although the main line of the railroad lies somewhat to the west of the new terminal, and on the meadows proper, the marshy condition of the soil where building was commenced, and the irregular profile of the location, necessitated that about one-half of the plant be erected on a fill, and a considerable amount of piling became imperative for foundation supports. Nevertheless, in the face of these engineering difficulties the work has been completed in a most satisfactory manner and thoroughly bears the impress of permanency.

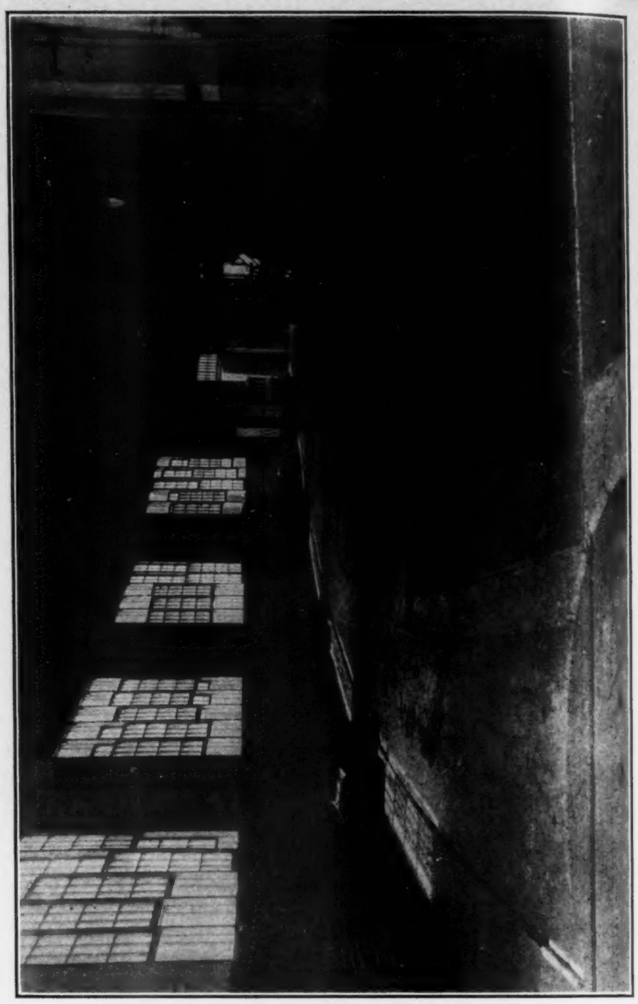
The buildings consist of a 32-stall roundhouse, with an 85-foot turntable operated by an electric tractor; a combined machine much smaller plants recently constructed, but where the various components have for some reason been isolated.

In further consideration of the general plan the fact of course becomes apparent that the ash pit is considerably removed from the roundhouse, but this location was considered most advisable in view of the possible erection in the future of an additional 25-stall roundhouse between the present one and the ash pits, thus allowing the latter to take care of any possible expansion without relocation. The absence of a coaling station in the immediate vicinity of the new plant is noticeable, but this arises from the fact that the old trestle is in too good condition to abandon, and the locomotives continue to coal at it as they pass on their way to and from the freight yard and passenger station in Weehawken. A large modern one, however, is contemplated and space reserved for it in connection with the new terminal, but it may not be constructed for a few years.

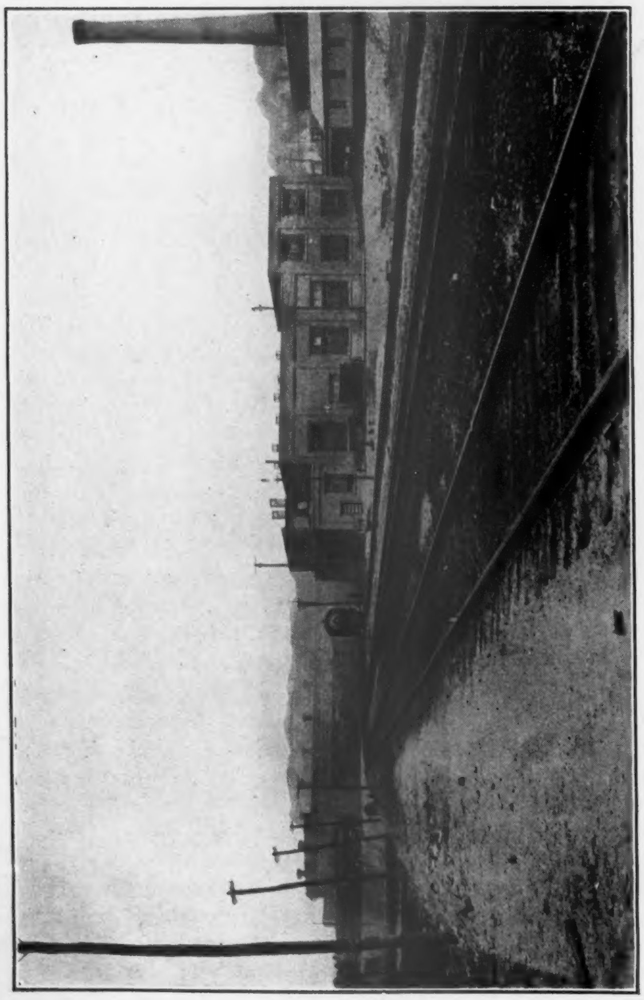
Differing from the plan employed at other points on the New York Central lines, inspection pits have not been provided in connection with this terminal, although they may receive consideration when the plant has become fully developed. At present the incoming locomotives are delivered to the shop at the ash pits, and the necessary inspections are made on their arrival at the roundhouse. The track arrangement is such, as will be seen in the plan, that the outgoing engines return in the same direction from which they entered, there being an independent track for their movement on the west of the ash pits. The total power handled is about 100 engines in 24 hours of all classes, passenger, freight and switching. Although the old erecting shop has been retained at the original plant, all of the heavier running repairs are cared for in the new roundhouse, and it is self-supporting so far as maintaining the locomotives is concerned until they are ready to receive classified work.



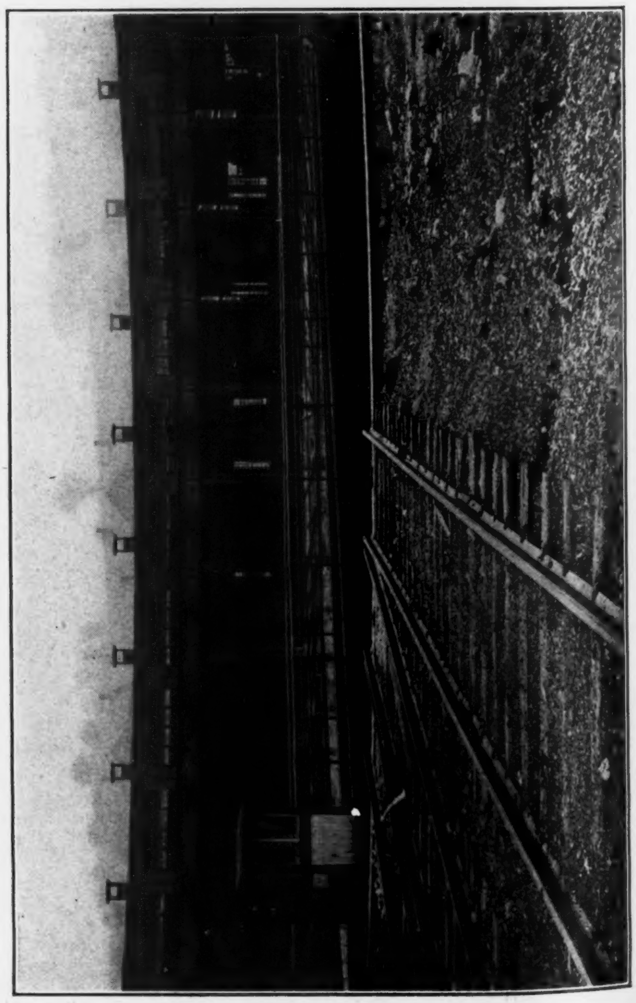
THE POWER HOUSE, CONTAINING WASHOUT SYSTEM AND AIR COMPRESSORS.



ROUNDHOUSE INTERIOR, SHOWING AMPLE CLEARANCE.



NEW DURHAM TERMINAL VIEWED FROM THE SOUTH.



ELECTRICALLY OPERATED TURNTABLE IN CONCRETE PIT.

The Roundhouse Structure.

This building in constructive features and general arrangement of details follows closely that at Corning, N. Y., and Springfield, Mass., on the same system, each of which has been described and illustrated in previous issues of this journal*, and which may be regarded as standard on the New York Central lines. The foundations are of concrete and the outside walls of brick, in two sections. The upper section, which encloses the roof trusses, is well provided with swinging windows, easily operated from the main floor, and which provide a very perfect system of ventilation. The question of heating and ventilation have, in fact, been most carefully considered in connection with this roundhouse, and the results have exceeded expectations. A very noticeable feature of this building is its absolute freedom from smoke and gas fumes, even when three or four engines are being fired up in one section simultaneously. Twenty-two of the smokejacks were designed by the Franklin Mfg. Co., 50 Church street, New York, and ten smokejacks by the Johns-Manville Co. of New York, and are most effective for the purpose intended. In these designs the jacks are of asbestos lumber, and having a length of 8 ft., permit considerable movement of the locomotive, a very important consideration in a terminal such as this where valve setting is frequently performed with the engine under steam. The jacks over the drop pits are made 31 ft. long, providing for the greatest possible range of position of the locomotive underneath.

Scarcely secondary in importance to this desirable feature is the heating system, which during the severest weather of the past winter thoroughly demonstrated its efficiency. In this installation the hot air blast system was erected complete by the Bayley Mfg. Co., of Milwaukee, Wis., in a fan room adjacent to and abutting from the west wall of the roundhouse.

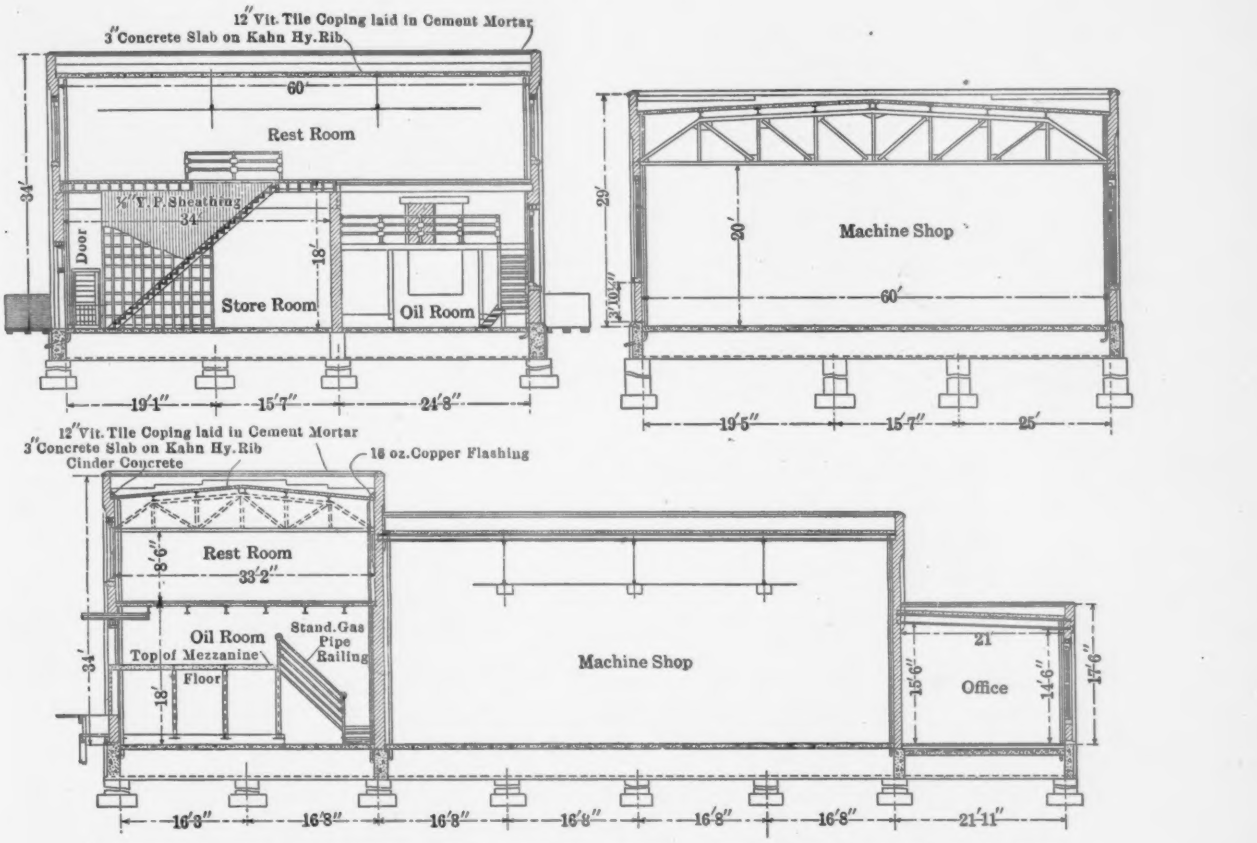
Two distinct fans and engines have been provided, both of which when operated at moderate load will maintain a temperature on the coldest days from 50 to 75 degrees F., provided that reasonable care is exercised in promptly closing the doors after incoming and outgoing engines. In moderate weather one heating unit will keep the house comfortable.

Ample provision has been made for the heavier locomotive repairs in connection with wheel dropping, and both engine and truck wheel removals, by providing two driver and two truck drop pits in the section of the roudhouse nearest the machine shop. This portion is also served by an industrial track equipped with conveniently arranged turntables. The design and construction of these pits, which are standard on this railroad, was described in the American Engineer, Dec., 1910, page 467. The tracks in which they are located are some 23 feet longer than those in other parts of the house, thus permitting the rear driving wheels to be handled on the engine drop pits without cutting the tender off and backing the locomotive in, which is a very customary procedure in many other less modern shops.

Machine Shop and Office Building.

The convenient proximity of this structure to the roundhouse has been commented upon. It is also of brick on concrete foundations, with an area of 60 feet by 120 feet, and contains on the first floor, from west to east, the office space, 21 feet by 60 feet, in which is included that of the master mechanic, chief clerk, roundhouse foreman, and the engine dispatcher, this portion of the building being connected to the roundhouse by a covered passageway; the machine shop, 66 feet by 60 feet; the storeroom, 33 feet by 34 feet, and the oil room, 24 feet by 33 feet. Over the latter two departments is a very commodious engineers' rest room, with a floor area of 33 feet by 60 feet. As will be noted from the sectional drawings herewith, this building is of the most substantial construction. It has been admirably planned for the convenience of the engine crews, who, for instance, after leaving their engines on the ash pit and on arriving at the shop building, pass first the engine dispatcher's office, where they register; next the oil room, where the cans are delivered, and from thence a stairway leads to the rest room should they care to make use of it.

The north side of this combination building has a 6-foot board walk, and immediately in the rear a high platform has been erected which gives access to the casting shed. These details are very clearly indicated in the general plan, and in this consideration it is interesting to note that in the event of the future 25-stall roundhouse being constructed it can be served with the same facility as the house now in operation.



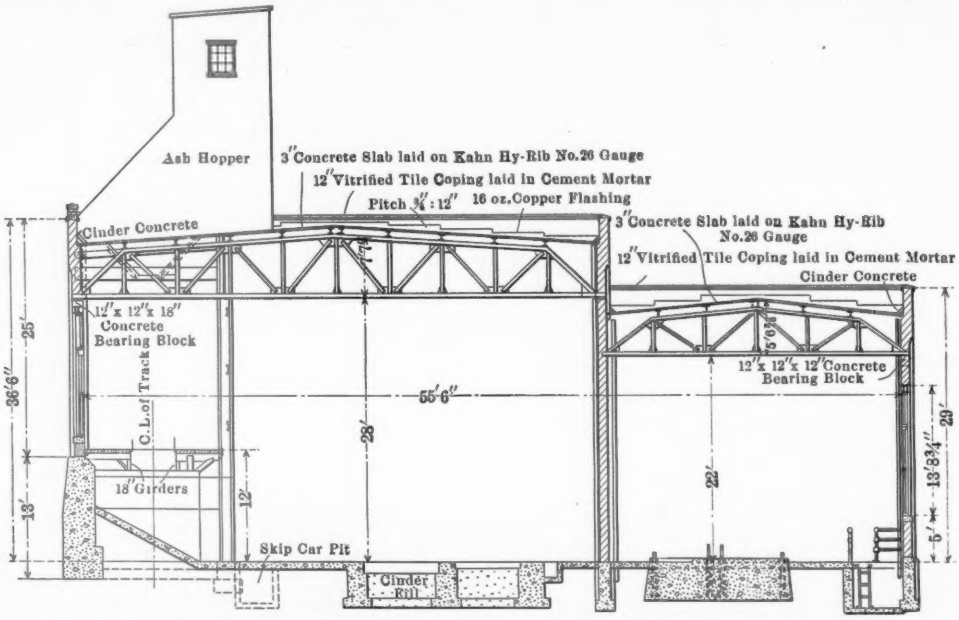
SECTIONAL VIEWS OF COMBINED STORE ROOM, OIL HOUSE, MACHINE SHOP AND OFFICE BUILDING.

*See Amer. Engr., Dec., 1910, and Jan., 1910, respectively.

THE POWER HOUSE.

This building embodies a departure from existing similar structures on the New York Central lines in many details, and may be said to present the most up-to-date construction and equipment in that line of any heretofore erected by this company. The area occupied is 77 feet by 87 feet, from west to east, as an engine room, 31 feet 6 inches in depth, and a boiler room 55 feet 6 inches deep, the latter having the full width of 77 feet. Fifteen feet of the engine room has been partitioned off to provide for an exceptionally well equipped toilet and wash room. The sectional drawing shows the principal dimensions of the two divisions of the building, which, it will be noted, are separated by a 12-inch wall. The equipment in the smaller section consists of a duplex Ingersoll-Rand air compressor, type H, with a capacity of 1,500 cubic feet of free air per minute, and the National Boiler Washing Company's system for hot water boiler washing and filling*, a duplicate of that which has been installed at Corning, N. Y., and at the other terminals of this company.

The demand imposed upon this system at New Durham is exceptionally severe, some fifteen boilers being washed daily, in addition to the usual number which are emptied or have the water lowered. The filling pump has a capacity of 500 gallons per minute, and the washout pump will take care of three boilers simultaneously, maintaining a pressure of 90 pounds. The filling water tank has a storage capacity of about 12,000 gallons, and the washout tank of about 8,500 gallons.



SECTION OF POWER HOUSE THROUGH BOILER AND ENGINE ROOM.

The arrangement of these appliances in the power house is particularly pleasing, and they have been so effectively disposed that notwithstanding their bulk and the large floor space occupied, the room appears to be quite open and unobstructed. This has been attained by placing the air compressor on the extreme right of the large double doors on the east side, and the boiler washing system on the extreme left, thereby leaving an open space of at least 20 feet between the two appliances, this space leading into the boiler room, which takes up the western end of the building.

INTERIOR OF BOILER ROOM—ASH HOIST ON LEFT

This section contains 3 water tube boilers built by Erie City Iron Works, of 300 horsepower each, an ample sufficiency to provide for all requirements of the plant. Ordinarily two boil-

* See AMER. ENGR., Dec., 1910, page 460.

ers will be sufficient to carry the load. The equipment of the boiler room includes a very effective automatic reversing pneumatic ash hoist, built and installed by R. H. Beaumont & Co., of Philadelphia, Pa. The general arrangement of this device consists of a self-dumping steel skip, of 20 cubic feet capacity, operated by a 14 inch by 14 foot air cylinder. The steel cable is reaved four times on the sheaves of the air cylinder, which provides for a 56-ft. lift of the skip.

As shown in the sectional drawing of the power house, the line of rails for the incoming coal cars containing the boiler room fuel supply is located 12 feet above the floor line, thus allowing these cars to be dumped into bins of large capacity, and this track also serves for the ash car when ashes are to be loaded. By reference to the above mentioned illustration, it will be seen that the operation of the skip is extremely simple. The fireman who dumps the barrow load of ashes into the skip merely pulls the cord attached to the air valve. The bucket then raises, dumps into an elevated ash pocket, and returns automatically to the filling pit. The advantage of the design is that air is always available around a railroad yard, and the use of an air cylinder makes certain the stopping of the skip at the upper and lower limits, more positively than any type of winding gear.

The remaining details of the New Durham plant are New York Central standards, which have been frequently alluded to in this journal. The terminal in general is a remarkably fine example of the development which all similar places are gradually undergoing, and is in striking contrast to the one just vacated, which for so many years cared for the power of the West Shore Railroad.

A TRIO OF ODDLY CONTRASTED LOCOMOTIVES

The largest two-stage compressed air locomotive in the world occupies the middle position in the odd assortment of machines represented in the accompanying illustration, which are a recent output of the H. K. Porter Co., of Pittsburgh, Pa. It is of the four-wheel type with a main reservoir consisting of three tanks 40 in. in diameter. Two of these are 15 feet long and the third is 17 feet, all being connected. This locomotive was built for use at a powder magazine. It will start five loaded freight cars on a level track and will haul two loaded steel coal cars a distance of five miles on one charge of air.

In view of the exceptional size and power of the engine the following principal dimensions may be of interest:

H. P. cylinder	11 x 18 in.
L. P. cylinder	22 x 18 in.
Wheels	36 in. diam.
Rigid wheelbase	5 ft. 9 in.
Weight of engine	55,000 pounds
Capacity main reservoir	375 cu. ft.
Tractive effort	10,000 pounds
Height	12 ft.
Width	9 ft. 6 in.
Length	21 ft. 11 in.
Pressure at throttle	250 pounds
L. P. cylinder pressure	50 pounds
Main reservoir pressure	825 pounds

The small steam locomotive which brings up the rear was built for plantation use in Nicaragua. It is of the four-wheel type with side tanks and a steel canopy cab. The cylinders are 5 x 10 in., driving wheels 20 in. diameter, and the rigid wheel base 3 ft. 6 in. The firebox is 26 x 18½ in., with a grate area of 3.34 sq. ft. The boiler, which is of the straight type, 23 in. diameter, has 37 1½ in. tubes, and its total heating surface is 58.9 sq. ft. Despite its diminutive proportions the little locomotive exerts a tractive effort of 1,700 lbs. It will operate on a 30 in. gauge track.

The switch engine leading the group well illustrates the care in finishing which has become so well identified with the output of the H. K. Porter Co. Its remarkably neat appearance for a locomotive of this type is very striking. With the exception of the relatively large boiler there is nothing particularly novel in the general design. The cylinders are 20 x 26 in.; driving wheels 50 in. diameter; tractive effort 35,360 lbs., and total weight 150,000 lbs. The avoidance of complication is prominent and all parts are readily accessible to ordinary running repairs.

NIGHT SCHOOL FOR APPRENTICES

At the Somerset shops of the Cincinnati, New Orleans & Texas Pacific Railway a school has been started for apprentices, which meets on Monday and Thursday nights of each week from 7 to 10 P. M. The railroad has fitted out a room with full equipment capable of accommodating 30 men and the State University of Kentucky furnishes the instructors and supervises the instruction. Beginning at seven o'clock at each instruction period from 30 minutes to an hour is spent by the instructor in discussing some feature of mechanical drawing, mathematics as pertaining to engineering, or some phase of engineering as affecting shop practice. The remaining time is allotted to drawing board work, where each student is allowed to progress as rapidly as his ability will permit.

Four instructors from the school of mechanical and electrical engineering have been assigned to this work, each instructor having the class for two weeks in turn. The apprentices are required to take this course and the expense to them is a maximum of $10 for drawing apparatus and material, all other expense being paid by the railroad.

This school has been started on the instance of T. O. Sechrist, master mechanic of the Ferguson shops at this point, who reports that six weeks operation indicates that the results of this plan are going to be most satisfactory and that the apprentices are taking a very keen interest in the advantages offered them.

The Speed and Power of Machine Tools

THE ENORMOUS IMPROVEMENTS IN TOOL STEEL AND THE MACHINES FOR USING IT HAVE RESULTED IN NEW PROBLEMS FOR THE MACHINE SHOP WHICH MAY BETTER ADMIT OF SOLUTION AFTER A CAREFUL REVIEW OF THE BEST RECCOMMENDED PRACTICE GOVERNING POWER, CUTS, SPEEDS AND FEEDS.

As a chip producer the lathe is the most economical of machine tools. A well-designed lathe, working under favorable conditions, produces a half-pound of chip per horsepower minute, when cutting mild steel. The pressure on a lathe tool, with this material, is, approximately, 100 tons per square inch area of cut, the latter being the depth multiplied by feed; i. e., a cut ½ in. deep by ⅛ in. feed, has an area of 1/16 sq. in. When cutting cast iron the pressure is about 50 tons per square inch, consequently about one pound of cast iron should be removed per horsepower minute. In a paper read before the English Northeast Coast Institution of Engineers and Shipbuilders, Joseph Chilton dealt very instructively with the speed and power of lathes and machine tools in general. The following discussion is based largely on the data presented in that excellent paper.

Fig. 1 shows the power required for cutting mild steel and cast iron under various conditions as given by Mr. Chilton.

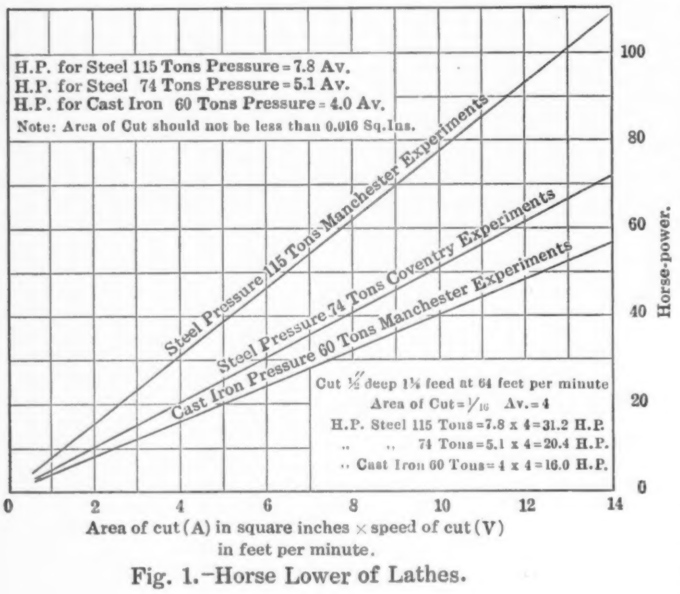


Fig. 1.—Horse Lower of Lathes.

The curve marked "Manchester experiments" is based on a tool pressure of 115 tons per square inch, which allows from 15 to 20 per cent. for friction losses in the machine. The lower curve for mild steel is based on experiments of Alfred Herbert & Co., Coventry, in 1909, when some remarkable results were obtained on a standard capstan lathe, using a tool with a cutting angle of 48 deg., a roller steady, and a copious supply of lubricant.

The power required for a given cut will probably lie between these two curves, as the pressure on the tool varies with the tool angle. Improvements in steel call for alterations in the cutting angle of tools; the better the steel, the more acute can be the cutting angle. The results of the Coventry experiments are interesting, and some of them are shown below. The lathe used admitted a 2¼ in. diameter bar, and the tests, which were carried out under practically commercial conditions, produced the following data:

Test. No.	Reducing. From Inches.	Reducing. To Inches.	Speed. Feet per Min.	Feed. Inches per Min.	Metal Removed. Cubic Inches per Min.	Lbs. per Min.
1	2¼	1	190	11⅜	36.29	10.16
2	2	¾	262	13⅜	36.11	10.11
3	1¾	¾	184	18⅛	35.52	9.94
4	2	1	210	14⅞	35.04	9.81
5	1¾	¾	229	17¾	34.79	9.74
6	2¼	1	236	10⅝	33.89	9.49

The maximum power required was, in test No. 2, 23.7 h.p. Ten years ago a lathe of this size used to be sold with a 2 h.p. motor, whereas one would now be required of 20 h.p. if work similar to the above was to be performed continuously. If the productive capacity of this lathe has increased in the same ratio as the power of the motors supplied, the result is a remarkable index of the progress of the past ten years. As a few examples of everyday practice it may be mentioned that straight shafting is finished from the rolled bar at 160 ft. per minute with 1/32 in. feed; 3 in. diam. shafting is therefore finished at the rate of 6.27 in. of length per minute, 10 ft. in less than 20 minutes. Three tools are used. A 10 in. lathe reduces mild steel forgings ¾ in. diam. with ⅛ in. feed at 60 ft. per minute. A 12 in. lathe reduces mild steel forgings 1 in. in diameter with ⅛ in. feed at 60 ft. per minute. A lathe more than 10 years of age, which has been converted into a direct motor drive, turns 8 in. diam. bolts at 300 ft. per minute, depth of cut ½ in., feed 1/32 in., removing 56 cub. in. of steel per minute. This lathe would probably require about 36 h.p. In an exceptional case an 18 in. lathe took a cut 1½ in. deep by ¼ in. feed at a cutting speed of 28 ft. per minute, the consumption of power being upwards of 80 h.p.

When exceptionally heavy duty is required from a lathe, the single pulley or the direct motor drive will usually be found to be most suitable. The motor, in the direct drive, should be of variable speed, not less than 3 to 1 variation, as this simplifies the change-speed gear and allows of exact speed adjustment. The table below of powers required is based on the belt power provided in some modern lathes.

Height of Centres	Horse-power Required.
6 in.	5
8½ in.	7½
10½ in.	10
12 in.	15
18 in.	30
24 ni.	40
36 in.	60

These powers enable heavy cuts to be carried in steel, the 18 in., 24 in. and 36 in. lathes using two tools.

Nicholson and Smith in their "Lathe Design" give a series of standard cuts and cutting speeds for lathes which are useful as a guide for power required. The standard cut for a 36 in. lathe is .9 deep, by .225 feed, giving an area of 0.203 sq. in., the standard cutting speed 20 ft. per minute. The standard cut for a 6 in. lathe is 0.15 deep by 0.0375 feed, giving an area of 0.0056, with the cutting speed 193 ft. per minute. These cuts and speeds are based upon the durability of the cutting edge of the tool. The tool in the 6 in. lathe is expected to last 16 minutes, and in the 36 in. lathe about 4 hours. Generally speaking, a heavy cut at medium speed is more economical than a light cut at high speed.

The Planing Machine.

The planing machine stands next to the lathe as a cutting remover. In it the high-speed problem has been solved in a scientific manner by both mechanical and electrical methods. The old type planing machine reversing gear is unsuitable for even moderate speeds. A large amount of energy is wasted at the end of each stroke, and a considerable amount of time is lost at each reversal of the table owing to the low accelerative and decelerative power of the gear. Mechanical and electrical systems of regenerative driving have changed this. The energy previously wasted in bringing the table and gearing to rest is now utilized in accelerating the table on its return stroke.

Typical power diagrams of planing machines are shown in Figs. 2-5. The diagram, Fig. 2, was taken from a machine with the old type of driving gear, and the diagram, Fig. 3, from

the same machine with an improved driving gear fitted. It will be seen that more power is needed for the return than for the cutting stroke; but Fig. 3 is an improvement in this respect, the "peak" at the moment of reversal is eliminated, and the power fluctuation minimized. Flywheels, constantly revolving in one direction, are used in this system of driving gear. The diagram, Fig. 4, was taken from a machine of the spring

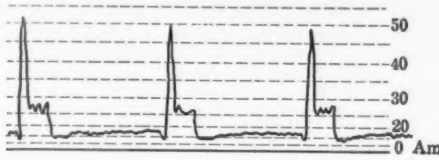


Fig. 2.–Ordinary Reversing Gear.

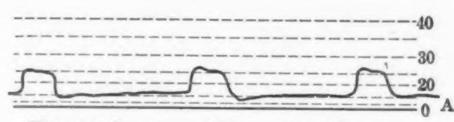


Fig. 3.–Improved Reversing Gear

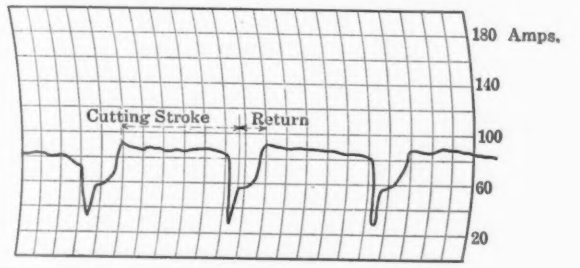


Fig. 4.–Spring Regenerative Reversing Gear.

Machine, 4 ft. by 4 ft. Planing steel ingot 8 ft. long. Cutting speed, 40 ft. per minute. Return, 180 ft. per minute.

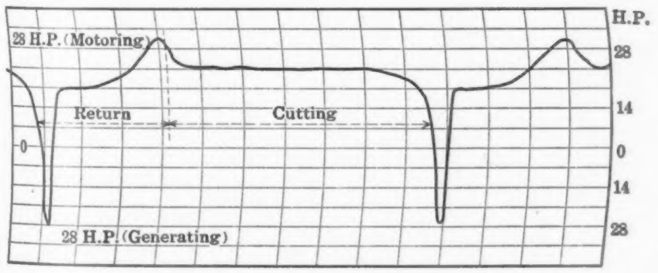


Fig. 5.–Electrical Regenerative Reversing Gear.

Machine, 6 ft. by 6 ft. Planing mild steel 18 ft. long. Cutting speed, 80 ft. per minute. Return, 160 ft. per minute.

regenerative type. This diagram shows the remarkable saving of power on the return stroke due to the action of the regenerative apparatus. The "peak" of the first diagram has become a "pit."

Diagram, Fig. 5, was taken from a machine driven by a reversible motor on the regenerative system. The power regeneration at the end of each cycle is strikingly shown. This machine was working on a long stroke, 18 ft.; the mechanical regenerative machine on a shorter stroke, about 8 ft., allowing for the difference in length of stroke and ratio of cutting to return speeds, and the similarity of diagrams is apparent. These regenerative planing machines, whether mechanical or electrical, represent the best modern practice in the line of driving arrangements.

To realize what can be done by the combination of a quick moving table and an effective feed motion, the spring regenerative planing machine from which the diagrams were taken can plane one square foot per tool per minute, while using a 5/16 in. feed. As the planing machine cuts in a straight line, the pressure on the tool per square inch of cut is probably less than in the lathe. Experiments in this direction are lacking. From 3 h.p. to 4 h.p. will be consumed per pound of steel removed per minute, in the best machines, working under the best conditions. For cast iron 2 h.p. to 3 h.p. per minute will be required per pound of chips.

Many old planing machines are of stout design, and may be speeded up considerably by a comparatively simple alteration in the driving gear. A modern machine, cutting at 60 ft. per minute will require from 25 h.p. to 35 h.p.

Speeds and Powers for High-speed Planers.

Size of Machine. Feet	Cutting Speeds. Feet per Minute.	Return Speed.	Horse-power.
2 × 2	30 to 90	200	7½
3 × 3	30 " 90	200	12½
4 × 4	25 to 75	180	20 to 25
6 × 6	20 to 60	160	30 to 35
8 × 8	20 to 60	140	35 to 40

Machines equipped with motors as above, with a length of stroke equal to 2½ or 3 times the width of the machine, should be capable of taking good cuts on steel on the highest speed. A point in connection with planing machine tools is that the clearance angle may be much less than in a lathe tool. The lathe tool when cutting works in a helical path relatively to the work, consequently the angle of clearance must be more than the angle of the helix. As the planing tool moves in a straight line relative to the work, a clearance angle from 2 deg. to 3 deg. is sufficient, against 5 deg. to 7 deg. for a lathe tool. A minimum clearance angle is of advantage in enabling the tool to withstand the shock of entering work at high speed.

Shaping and Slotting Machines.

These machines are straight-line cutters, like the planing machine, but, in their usual sizes, are not subject to the handicap of the reversal of the rotating parts. Consequently increased speeds are more readily obtainable than in the case of the planing machine. The improvements of recent years have been mostly in the direction of increased handiness. The American type of shaper, where the length of stroke can be adjusted and the ram positioned while the machine is in motion is a case in point. The grouping of operating handles, so that the workman can control all motions of the table from one position, and improved means of quickly adjusting length of stroke and feed in the slotting machine, is another case. The hammer and anvil-like construction of the slotting machine enable it to carry heavy cuts without vibration. The shaper, as a rule, is not adapted for such heavy cuts.

H. J. Brackenbury, in his 1910 paper read at the joint summet meeting of the Institution of Mechanical Engineers and the American Society of Engineers, gives particulars of a 10 in. stroke and 6 in. slotting machine as follows:

Size of Machine Inches.	Strokes per Minute.	Cut to Inches. Length,	Depth.	Feed Inches	Superficial Area covered per Minute Square Inches.	Material Removed per Minute Lbs.
10	45	10	5/8	1/20	22.5	4
6	65	6	3/8	1/20	19.5	2

These cuts were taken in steel without any sign of jar or vibration in the machines. Assuming a quick return ratio of 2 to 1, the average cutting speed on the 10 in. stroke is 56 ft. per minute, and on the 6 in. stroke, 49 ft. per minute. The power required would be about 15 h.p. and 7½ h.p., respectively, when taking the cuts mentioned in the tests.

From the belt power of a group of shapers of the American type the following table has been computed:

Length of Stroke Inches	Cutting Strokes	Horse-power per Minute.
14	10 to 130	3
16	7 " 125	4
20	6 " 110	5
24	6 " 100	7½
36	6 " 70	10

The Milling Machine.

Milling is an economic process, especially on repetition work. A large number of milling machines are single purpose tools; that is, designed to do one job only. The speed and feed requirements of a machine for general work are (1) the quickest spindle speed should be fast enough for the smallest cutter used on the machine. (2) The slowest spindle speed should be slow enough for the largest cutter. (3) Every diameter of cutter in ordinary use should have a range of feeds sufficient to enable it to do efficient milling according to its class. A

general machine should, therefore, have an ample range of speeds and feeds, the rate of feed being independent of the spindle speed.

An instructive series of tests were carried out in 1909 by Alfred Herbert, Ltd., Co., Coventry, on one of their standard machines, the weight of which was about 1½ tons. A spiral cutter 3 in. diameter by 6 in. long, with eight teeth, was used at a constant speed of 66 ft. per minute, preliminary experiments having shown this to be a good speed for heavy cutting. The maximum metal removed per horsepower minute was 1.52 cubic in. for cast iron, and .71 cubic in. for mild steel. The maximum total output obtained was 15.23 cubic ft. per minute on cast iron, and 6.27 cubic in. per minute on steel. The greatest output on cast iron was obtained with a cut ⅝ in. deep, at a feed of 9½ in. per minute, from which it might be inferred that on cast iron it pays to take off as much as possible in one cut, whereas on mild steel shallower cuts at quicker feeds might be more economical. The maximum net horsepower used in these tests was 12.3, which indicates a large productive capacity for so small a machine.

In the Transactions of the American Society of Engineers, 1908, tests of a built-up spiral cutter, 8 in. diameter, 18 in. long with inserted blades, are described. This cutter in one test required 96 h.p. and removed mild steel at the rate of 80 lbs. per hour. The speed in this test was 75½ feet per minute, and the feed ⅜ in. deep by 7 in. per minute. It has been computed that 300 h.p. would be required to drive this cutter to its full capacity at from 150 lbs. to 180 ft. per minute. The milling cutter is evidently in advance of the machine.

Tests seem to show that built-up cutters are superior to solid cutters as material removers, owing to the fact that a more acute cutting angle can be obtained, and the construction of the cutter is more favorable to the escape of the cuttings. Milling cutter speeds vary greatly according to the work required of them. Sixty-six feet per minute is probably a good average speed, having regard to durability of the cutter. The feeds may vary from ½ in. to 30 in. per minute in extreme cases. Tests show that in some cases 33 per cent. of the power supplied to the machine is absorbed in driving the feed gear when carrying heavy cuts. It is evident from this that milling machines' spindles should be rigidly supported, and should be as stiff as possible if heavy duty is expected from them.

The Drilling Machine.

The penetrative power of high-speed drills is remarkable; a 1 in. diam. drill has worked at the rate of 18 in. per minute on cast iron and 12 in. per minute on mild steel. These are rates obtained in rigid machines using special drills. In ordinary practice the above rates cannot be kept up for any length of time. Too much attention would be requisite in grinding and keeping the drills in proper condition, besides which there would be an undue proportion of drill breakages. One-half of the above rates is good practice, and it is only on modern high-speed machines that the latter rate can be maintained. Experiments show that a medium peripheral speed and a coarse feed give a smaller power consumption per inch of depth than a high peripheral speed and a fine feed. Drills of high-speed steel possess sufficient torsional strength to stand coarse feeds; coarse feeds increase the drill pressure, hence the necessity for rigid machines and positive feeds if it is required to use high-speed drills economically.

The following table is given by Mr. Dempster Smith. It is based upon a run of 1½ hours without regrinding:

Diameter of Drill.	Feed per Revolution.		Revolutions per Minute.	
	Soft Cast Iron	Soft Steel.	Soft Cast	Soft Steel.
Inches.	Inch.	Inch.	Iron.	
¼	1/133	1/160	2560	2820
½	1/160	1/126	900	1000
1	1/84	1/100	320	357
2	1/67	1/79.5	113	127
3	1/58.4	1/69.5	61.5	68.5
4	1/52.8	1/63	40	44.6

Compared with the speeds recommended by twist-drill makers, the above speeds are excessive for the smaller sizes and low for the larger. To take full advantage of high-speed drills, machines of the sensitive type are required for sizes under 1 in. diam., while for sizes from 2 in. to 4 in. diam. stiff and powerful machines are necessary to take advantage of the coarse feeds. More drill breakages are caused by want of rigidity in machines than by high speeds and coarse feeds.

The net power required to drill a 4 in. diam. hole at the feed and speed given in the above table is 9 h.p., when operating on steel. The thrust of a 3 in. diam. drill at 1/50 feed in about 7,600 lbs. when drilling medium steel with the drill in good condition. Tapping can be done at about one-third the speed of drilling.

Boring varies so much in character that every job is a law unto itself. Speeds from 20 ft. to 80 ft. per minute, with feeds from 1/50 in. to ½ in. per revolution, are obtainable in various cases.

Grinding Machines.

Grinding machines, apart from those used in the sharpening of tools, are essentially products of modern machine-shop practice. No well-organized machine shop is complete without a grinding machine of some type, for finishing work which has been roughed in some machine of the lathe, planer, or miller type. Grinding is practically a milling process, the grinding wheel being a cutter with a large number of small teeth, which renew themselves automatically when blunted. As a material remover, the grinding machine is not an economical user of power, but for speed and accuracy of finish, when only a small amount of material is to be removed, it has no rival. Grinding machines are adapted for finishing work of the heaviest class. A machine has been built for grinding shafts up to 3 ft. diam. and 33 ft. long. This machine is driven by three independent motors; the work is rotated by a 16 h.p. motor, the grinding wheel by a 30 h.p. motor, while the saddle which carries the grinding wheel is traversed by a 5 h.p. motor. The three motions, work rotation, wheel rotation, and feed traverse, may be varied independently of each other, an essential condition in a well-designed machine.

The whole question of grinding machine speeds and feeds is so complex that it is impossible to do more than generalize in regard to the same. The speed combinations now generally adopted differ considerably from those which were formerly considered correct practice. The developments have been in the direction of increased wheel speeds, increased feed traverse, and reduced speeds of work rotation.

The wheel speeds vary according to the grit and grade of the wheel, the material worked on, and also its size and condition. The nature of the finish desired has also to be taken into account, and in this way the speeds vary from 4,000 ft. to 6,000 ft. per minute.

The feed traverse in a cylindrical grinder is mainly regulated by the width of the wheel used. The traverse per revolution of the work must be less than the width of the wheel. The depth of cut and the character of the work also affect the feed traverse, which may be anything from 1 in. to 60 in. per minute.

With regard to power required, the writer has no record of exact experiments. One maker of cylindrical grinding machines fits a 5 h.p. motor to a machine using a 20 in. diam. wheel 2 in. wide; another maker recommends a 10 h.p. motor for the same size of wheel. The following table, based on the belt power of Norton standard grinding machines, may be of some value:

Number of Wheels.	Maximum Diameter and Thickness of Wheels. Inches.	Maximum Horse power.
1	12 × 2	2.0
1	30 × 4	9.5
2	6 × 1	1.5
2	10 × 1½	3.0
2	12 × 2	4.0
2	16 × 3	8.0
2	24 × 4	9.5
2	36 × 4	11.0

The machines from which the above table is taken have no feed motion, consequently the whole of the power is available at the wheels. In cylindrical grinders about 50 per cent. extra will be required for work rotation and feed traverse.

As an example of grinding work, a machine with a wheel 24 in. diam. by 2 in. face finishes a shaft rough-turned with a 12 per inch feed, 1/100 in. above size at the bottom of the tool

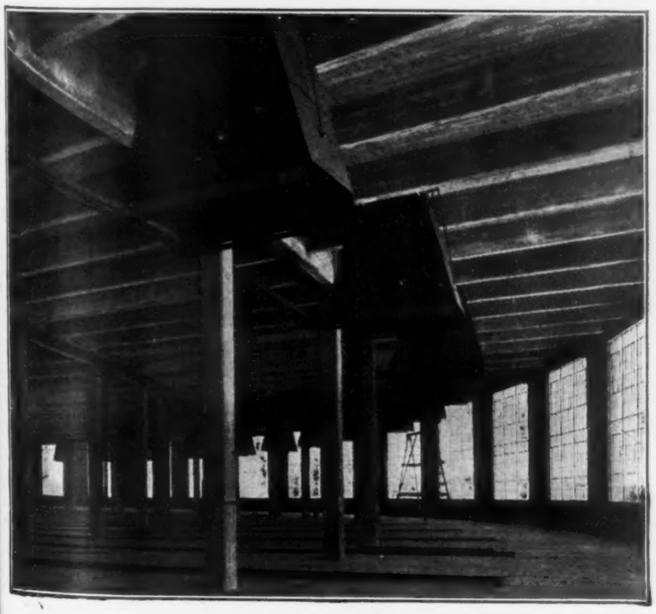
marks, 4 in. diam., 3 ft. long, in six minutes. A piston rod, 2¾ in. diam., 34 in. long, rough-turned with a 6 per inch feed 1/32 in. above size, is finished in 14 minutes, the speed of the wheel in the latter case being 6,500 ft. per minute, the speed of work rotation 45 ft. per minute, and the feed traverse 8 in. per minute.

NEW DESIGN ROUNDHOUSE SMOKE JACK

In view of the diversified nature of repairs made to locomotives while in the roundhouse, many of which, in particular valve setting, requiring that it shall be frequently moved under its own steam, it becomes necessary to provide a means which will permit of this movement in addition to its primary function of keeping the house free from smoke.

The smoke jacks shown in the accompanying illustration of a concrete roundhouse interior were designed and manufactured by Paul Dickinson, Inc., Chicago, Ill. Several new ideas are embodied in the design, the whole affording an adequate and exceptionally substantial cast iron arrangement. It will be noted that the pitch at the ends of the hood is very steep, this being necessary on account of the great velocity of steam and smoke when the blower is used to fire up the locomotive.

It is impossible for the smoke and steam to choke in the upper part of the hood in the presence of this scientific construction. Since the locomotive stack is not always in the center of the track, arising from the necessity of at times jacking it higher on one side than the other, a wide hood is required, and this desirable feature has been attained in this design through the flared hanging sides of the hood which are added to increase the width so that the smoke from the stack can always be collected.



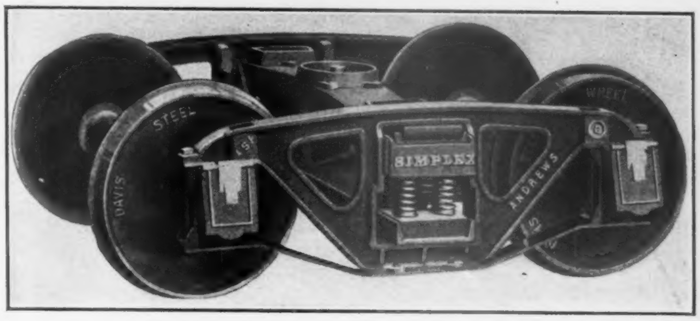
DICKINSON SMOKE JACKS IN A CONCRETE ROUNDHOUSE.

To keep the roundhouse clear of smoke and steam while the locomotives are passing in or out, a ventilator was furnished around the pipe at the roof line, in the instance of the house illustrated. This idea has been found particularly valuable, as it takes care of the smoke at the point most easily handled. To retain the heat in the roundhouse when the smoke jack is not in use a damper was furnished. This is operated by means of a sliding weight or ball connected to the damper in the manner shown, the ball holding the latter in an open or closed position as may be desired.

Plans Have Been Prepared for large new repair shops for the Canadian Pacific Railway at Coquitlam, British Columbia. It is stated that the shops will extend for nearly two miles.

FREIGHT CAR TRUCK OF 70 TONS CAPACITY

The American Steel Foundries exhibited at the Atlantic City Convention a complete freight car truck suitable for use under 70 or 75 ton equipment. This truck, as shown by the accompanying illustration, is of their usual construction, which has been adopted as standard on a number of the large railway



systems. The design is of particular interest in view of the light total weight represented, which is only 8,600 pounds.

The great strength of metal used in the manufacture of the Davis cast steel wheels has made it possible to reduce their weight to about 600 pounds each. If it were possible to make a cast iron wheel which would be suitable for a truck of this capacity such wheels would weigh not less than 850 or 900 pounds each, and rolled steel or steel tired wheels would weigh even more. Therefore in the use of the Davis wheels a reduction in weight of 1,000 pounds per truck, or 2,000 pounds per car is obtained. The Andrews side frames weigh 500 pounds each, or 1,000 pounds per truck, a saving of at least 250 pounds per truck, or 500 pounds per car, over arch bar construction. The Simplex bolster weighs about 950 pounds, the axles about the same, and the journal boxes 125 pounds each.

In a truck of this capacity any saving which can be effected in its weight is not only important so far as the cost of hauling the extra weight is concerned, but has an indirect value in lowering the cost of track and bridge maintenance. Different railways have various ways of figuring their actual cost of hauling one ton one mile, but there are few roads which figure the cost at less than ¼ cent per ton mile.

If computed on this basis, and using an estimated figure for the probable mileage which the car will make during its life, the saving in weight of 2,500 pounds per car as effected in this example, results in some surprisingly large figures, which it is difficult to disregard. When this result is multiplied by the number of high capacity cars in service the sum total is amazing.

The truck tests recently made at the Granite City plant of the American Steel Foundries* show the necessity for a rigid fastening between the two side frames, to hold the truck square and prevent one side frame getting ahead of the other one when the truck is passing around curves. In this truck the two side frames are held rigidly at right angles with the axles by a heavy channel spring plank, which is riveted to each frame with 10 rivets.

A loose truck, or one with a spring plank connection which permits the wheels on one side to get ahead of the others, allows the truck to become skewed in passing around curves, and it runs in this condition for a considerable length of time after the truck gets onto a tangent. This causes the wheels on the outer side of the curve to grind against the rail, increasing the resistance of the truck and decreasing by a corresponding amount the hauling capacity of the motive power. Reduced to pounds per ton, the Granite City tests showed a resistance of 38.33 pounds on a 22-degree curve for a loose truck, while for a square truck it was only 24.68 pounds, a difference in favor of the square truck of 13.65 pounds, or 35.6 per cent. To push a loose truck around a 22-degree curve required the combined efforts of from 5 to 7 men, while to push a square truck around the same curve only two men were required.

* See American Engineer, May, 1911, page 192.

HEAVY HIGH DUTY PACIFIC TYPE LOCOMOTIVES

MINNEAPOLIS, ST. PAUL & SAULT STE. MARIE RY.

An order of ten Pacific type locomotives has recently been delivered to the Minneapolis, St. Paul & Sault Ste. Marie Railway by the American Locomotive Company, one of which is illustrated herewith. These engines are representative of the latest development of the modern high duty passenger locomotive. The design which was prepared by the builders represents their most approved practice for engines of this class, embodying as it does in one engine practically all the new features which have been successfully applied by them during the past two years to other engines of a similar class. They constitute the latest of an interesting series of design of Pacific type locomotives, each one heavier and more powerful than the preceding.

The story of this development on the Soo Line is told by the following table, and is typical of what other roads have had to do in their effort to meet increased requirements or to improve service.

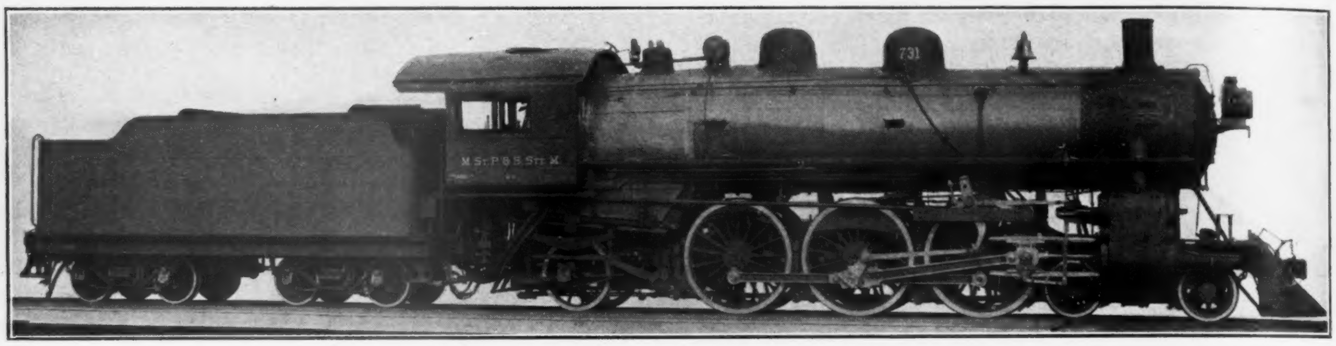
Year.	1904-1909.	1910.	1911.
Weight on driving wheels, lbs......	131,000	147,500	158,000
Total weight, lbs....................	206,000	221,000	258,000
Cylinders diameter and stroke, in....	20 x 26	24½ x 26	25 x 26
Driving wheels, diameter, in.........	69	69	75
Boiler pressure, pounds per sq. in....	200	160	180
Total heating surface, sq. ft..	2,877.3	2,876	3,522
Superheater heating surface, sq. ft...	......	515	805
Grate area, sq. ft....................	43.9	47	52.8
Tractive power, lbs...................	25,600	30,800	33,200

During seven years, from 1904 to 1911, there has been an increase in weight of 52,000 pounds, and 7,600 pounds in tractive power. Also, the design which a year ago was considered adequate to meet the requirements has been superseded by one 37,000 pounds heavier and having 2,400 pounds more tractive power.

Part of this present order will be used on the Chicago division between Chicago and Minneapolis, and the remainder on the Soo division. The former division is over very rolling country. In the 460 miles between Chicago and Trout Brook Junction there is only about 85 miles of level track. In going north from Chicago there are 191 miles of ascending grades, of which about 24 miles are at least 1 per cent., the maximum being 1.21 per cent. The longest ascent going in this direction is between Gillis Landing and Custer, a distance of 31.6 miles, in which there is a rise of 414 feet. Traveling south there are 184 miles of ascending grade, of which about 16 miles is at least .8 per cent., the maximum being 1.2 per cent.

Their fast trains have a schedule from Chicago to Minneapolis of 14 hours and 25 minutes (including stops) or an average speed of 33 miles per hour, while in the other direction the schedule time is 14 hours and 35 minutes, or 10 minutes slower, giving an average speed of 32.6 miles per hour. Present traffic conditions necessitate running more cars on their through limited trains, and in ordering these heavier engines it is the purpose of the Soo Line management to increase these trains to 12 cars and operate them on the same schedule as is now in force for the lighter trains. Definite limits are set for the maximum speed on the descending grades, so that in order to maintain the schedule these new engines will have to handle 12 cars on the up grades at the same speed as the present type handles the lighter trains.

Like the class which they supersede, the engines here illustrated are equipped with fire tube superheaters of the side header type. Their weight of 258,000 pounds and tractive power of 33,200 pounds places them among the most powerful engines of their class. Among the new features embodied in this design will be noticed the steam pipe arrangement having an outside connection with the cylinders. A similar arrangement was applied by these builders to a recent order of Pacific type locomotives built for the New York Central, and in a number of other instances. This arrangement provides more free area in the smoke box under the table plate for the waste gases than the ordinary arrangement. It also greatly simplifies and strengthens the coring of the cylinder casting and, taken as a whole, provides for the simplest and most direct passage of steam from the superheater header to the steam chest, and one open to inspection for its entire length.



NEW 4-6-2 LOCOMOTIVE FOR THE SOO LINE.

Another example of the builder's latest practice is the design of the Walschaert valve gear crosshead and guide. The guide is an integral part of the valve chamber head and is centered by the bore of the valve chamber, thus insuring absolute alignment of the crosshead and valve stem. The guides are of the four-bar type. Each of the upper guides is formed of a separate piece bolted to its corresponding lower guide, and between the two pieces is a liner plate which makes it possible to easily adjust the guides for any wear.

The trailing truck is the builder's improved design of outside bearing radial truck with floating spring seat yoke, which has been successfully applied to a large number of recent Pacific type locomotives built by them. This type of truck is of a very much simpler construction than their older design and saves a considerable amount of weight. Compared with their former truck of the same class there is a difference of from 2,500 to 300 pounds in favor of the design here applied. Extended rods are used for both pistons and valves following the latest practice with superheated steam.

Throughout the whole design there is evidence of special attention in working out the details to keeping the weight of the parts of the engine and running gear as low as possible, consistent with strength in order to provide the maximum boiler capacity within the given total weight of engine.

The general dimensions and ratios are as follows:

GENERAL DATA.

Gauge	4 ft. 8½ in.
Service	Pass.
Fuel	Bit. Coal
Tractive power	33,200 lbs.
Weight in working order	258,000 lbs.
Weight on drivers	158,000 lbs.
Weight of engine and tender in working order	401,200 lbs.
Wheel base, driving	13 ft. 6 in.
Wheel base, total	34 ft. 7 in.
Wheel base, engine and tender	66 ft. 2¼ in.

RATIOS.

Weight on drivers ÷ tractive effort	4.75
Total weight ÷ by tractive effort	7.76
Tractice effort × diam. drivers ÷ heating surface	706.98
Total heating surface ÷grate area	66.89
Fire box heating surface ÷ total heating surface	5.87
Weight on drivers ÷ total heating surface	44.86
Total weight ÷ total heating surface	73.25

CYLINDERS.

Kind	Simple
Diameter and stroke	25 x 26 in.

VALVES.	
Kind	Piston
Diameter	14 in.
Greatest travel	6½ in.
Outside lap	1⅛ in.
Inside clearance	⅛ in.
Lead in full gear	F 1/16, B 7/16 in.
WHEELS.	
Driving, diameter over tires	75 in.
Driving, thickness of tires	3½ in.
Driving journals, main, diameter and length	10½ x 12 in.
Driving journals, others, diameter and length	10 x12 in.
Engine truck wheels, diameter	36 in.
Engine truck, journals	6 x 12 in.
Trailing truck wheels, diameter	50 in.
Trailing truck journals	8 x 14 in.
BOILER.	
Style	Ext. Wagon Top
Working pressure	180 lbs.
Outside diameter of first ring	72 in.
Firebox, length and width	108⅛ x 70¼ in.
Firebox plates, thickness	S. & B. ⅜ in., F. ½ in., C. ⅜ in.
Firebox, water space	4½ in.
Tubes, number and outside diameter	217—2 in.
Tubes, length	21 ft.
Heating surface, tubes	3,315 sq. ft.
Heating surface, firebox	207 sq. ft.
Heating surface, total	3,522 sq. ft.
Superheater heating surface	805 sq. ft.
Great area	52.8 sq. ft.
Smokestack, diameter	18 in.
Smokestack, height above rail	15 ft. 6 in.
TENDER.	
Frame	Steel channels
Wheels, diameter	36 in.
Journals, diameter and length	5½ x 10 in.
Water capacity	7,500 gal.
Coal capacity	12 tons

COMMUTATING POLE MOTOR OF NEW TYPE

The severe service that electric motors are called upon to perform in many industrial power applications, and the consequent necessity for reliability and efficient all-day operation, requires the use of machines possessing exceptionally good commutation, overload and heating characteristics, combined with great mechanical ruggedness. The type "CVC" commutating pole motor, just brought out by the General Electric Company, has been specifically designed to meet such requirements.

The reason for the commutating pole design may be readily understood if it be remembered that sparking under the brush of a non-commutating pole D. C. machine is almost wholly due to the absence of a magnetic field, automatic in action and of sufficient intensity to reverse the armature coils successively

3-horsepower "CVC" motor.

short-circuited as corresponding segments pass under the brushes. The commutating poles of "CVC" motors are connected in series one with another, and also with the armature; their magnetizing power is, therefore, in proportion to the armature current, and may consequently be employed to compensate for armature reaction, allowing sparkless commutation over wide ranges of load and under adverse conditions of operation. In addition to the above, commutating pole motors allow a wider range of speed control by field than is permitted with motors of non-commutating pole design.

Internal ventilation is secured by a very simple, rigid and durable form of fan mounted on the armature shaft within the

"CVC" motor with belt tightener.

pulley end bearing head. This fan, while consuming a negligible amount of energy, insures cool operation under very severe conditions of temperature and load. Internal ventilation has been advantageously applied to transformers, motor generator sets, etc., for a number of years. A similar application in motor practice is entirely logical, natural, and in step with the most advanced engineering practice. The main field coils are wound on strong horn fibre spools, amply insulated with pressboard, mica, varnished cambric, etc., to insure freedom from breakdown under possible excess potential strains. The windings are rendered moisture-proof by thorough impregnation with a special insulating compound. Before final assembly the coils are armor-wound with a single layer of enamel-covered wire, serving the double purpose of protecting the active windings from mechanical injury and assisting to a higher degree of heat radiation. The commutating poles are wound with rectangular copper wire, the coils being assembled on horn fibre spools, which thoroughly insulate the coils from the pole pieces.

Special pains have been taken to so design the commutator that complete immunity will exist from loose or "high" bars. The commutator bars are insulated from one another and from the commutator shell by selected sheet mica, micrometer gauged to a uniform thickness and of proper hardness to wear down evenly with the copper. The outer corners of the segments are rounded to prevent chipping of the mica and the inner edges are notched out to prevent short-circuiting between the bars. There are small grooves in both the flat sides of the copper segments which serve, when the commutator is hydraulically pressed in its assembly ring, to firmly anchor the mica insulating segments, thus avoiding the possibility of high mica.

The bearing heads being interchangeable, the relation of the terminal block to the commutator and pulley end heads may be shifted by removing the heads, turning the armature end for end, and finally replacing the heads to correspond with the reversed armature position. It is thus possible to have the terminal block accessible under varying conditions of installation. The bearing linings are large, and thorough lubrication is ensured by the use of heavy oil rings of generous cross section. All bearing brackets and frames are drilled and tapped symmetrically so that motors may be readily arranged for side wall or ceiling suspension by turning the bearing heads 90° or 180° respectively with relation to the frame.

Good Castings do not Depend upon the mixture of metals composing them, but upon foundry practice. With the right foundry practice good castings may be made of any mixture.

BORING LOCOMOTIVE DRIVING BOXES.

CHARLES D. CHANDLER.

While the accomplishment of this operation is as old as the locomotive industry, and taken in a number of different shops, would likely have as many slightly various methods, relative to size, either securing same by bolting the box to the face plate of an engine lathe, horizontal bar, or merely clamping the box on a vertical mill table, irrespective of any fixed accuracy in setting.

The high degree of perfection and specialization to which machine tools and steel making has arrived, would seem naturally to suggest the application of the most expeditious and accurate in present-day shop practice. In considering perfecting the development of any kind of work results sometimes fall short of expectations for lack of correct and ample facilities. True also under some policies of supervision, is the fact that fear often exceeds liberality in an original tryout on any job, resulting in establishing a general under capacity, whereas, taking an operation of daily occurrence and increasing demand, almost any reasonable expenditure to the point of momentary extravagance, would eventually justify the first cost.

FIG. 1.

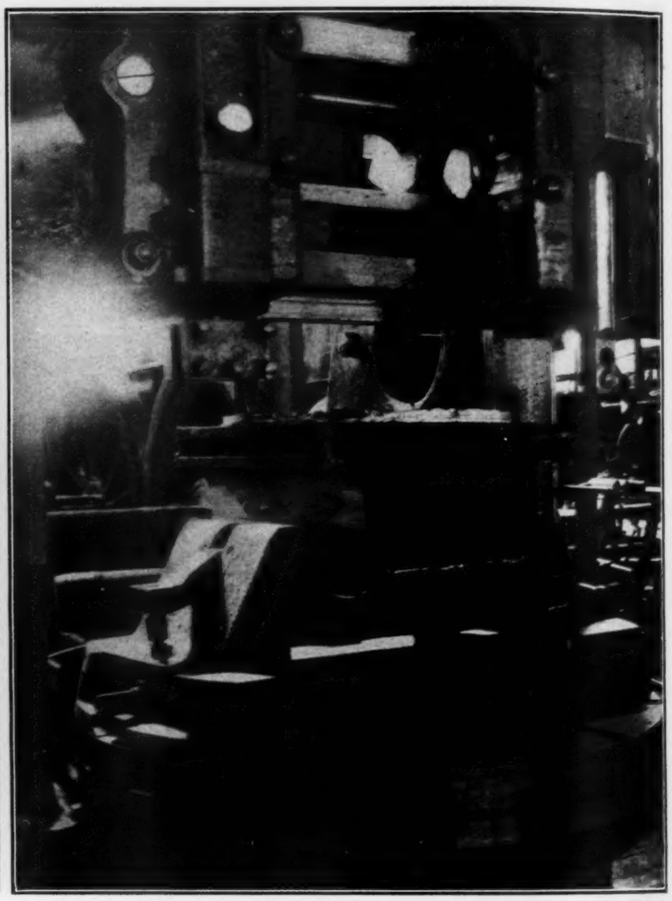
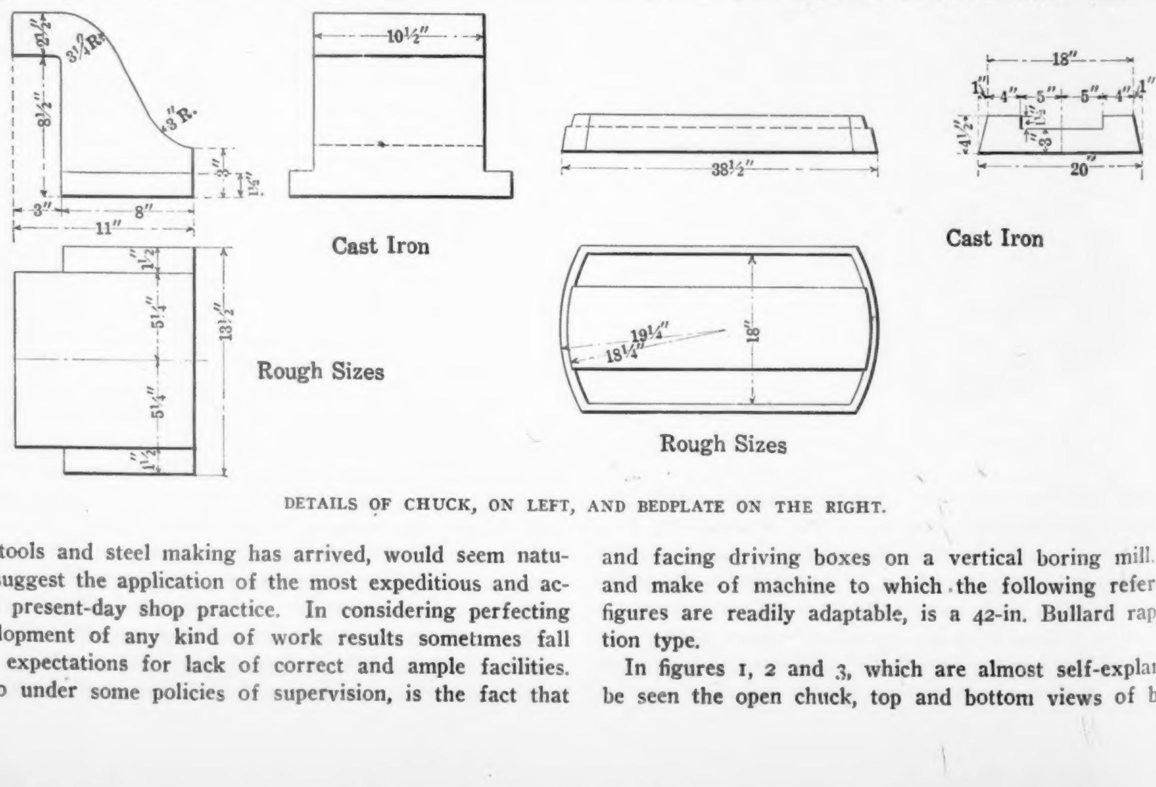


FIG. 2.

Having determined on an ideal result, it is as easy in point of manipulation, irrespective of magnitude, to chuck a modern driving box as it is to chuck a rod bushing, cylinder or piston head or perform any other of the most familiar operations. With the aid of the accompanying illustrations and line sketches a clear understanding may be obtained of a most efficient, rigid and extremely accurate two-jawed universal chuck for boring and facing driving boxes on a vertical boring mill. The size and make of machine to which the following refers, and the figures are readily adaptable, is a 42-in. Bullard rapid production type.



DETAILS OF CHUCK, ON LEFT, AND BEDPLATE ON THE RIGHT.

In figures 1, 2 and 3, which are almost self-explanatory, can be seen the open chuck, top and bottom views of box in two

working positions, manner of handling tools for same. The line drawing gives working size dimensions of castings for the chuck on the left and its bedplate on the right, and as occasion suggests could be slightly altered to suit any local condition, style of equipment or mill. Mentionable features of merit about this device is an universal movement and liberal contact surfaces of the chuck jaws, 40 or 50 square inches.

Having predetermined the amount to bore out of the crown of the brass, either old or new bearings, it is only necessary to push the box into the chuck a sufficient distance that the finish cut will be on a radius half the diameter of the journal measured from the central point in the chuck base, also an easy and accurate way to set a box so the crown will be sure to true up full length of bore. Noting figure 2 left side rapid traverse head into position for facing babbitt lateral to flange thickness, accomplished in a few minutes and head withdrawn, a combination square is then tried on the new face at the crown surface shows whether metal is "full" or "scant" at bottom of bore. The right head with boring bar is run into center position over mill table, measuring from the bar one-half the journal size less one-half the diameter of bar, will give a point to where the crown surface should be moved to make the cut true up. Aside from finding the point to where the crown cut will run it is quite apparent that all laying out is entirely eliminated.

The little levers seen fulcrumed midway on the outside of both chuck jaws also extend into and overlap the lower box flanges. Small pieces of blocking are used under the inside ends of these levers and the vertical security is assured by screwing out on the small inverted screws pivoted into the outside ends of the levers, thus forcing the whole box down onto the three-point parallel strips on the chuck base. In machining the bedplate it is well to leave a central boss projecting from the bottom which will drop into the spindle hole in the mill table. A right and left double-ended screw relieved of thread in center and square shouldered up against a smooth-bored split anchor plate centrally secured lengthwise of the bedplate, provides amply for thrust of the jaws. Right and

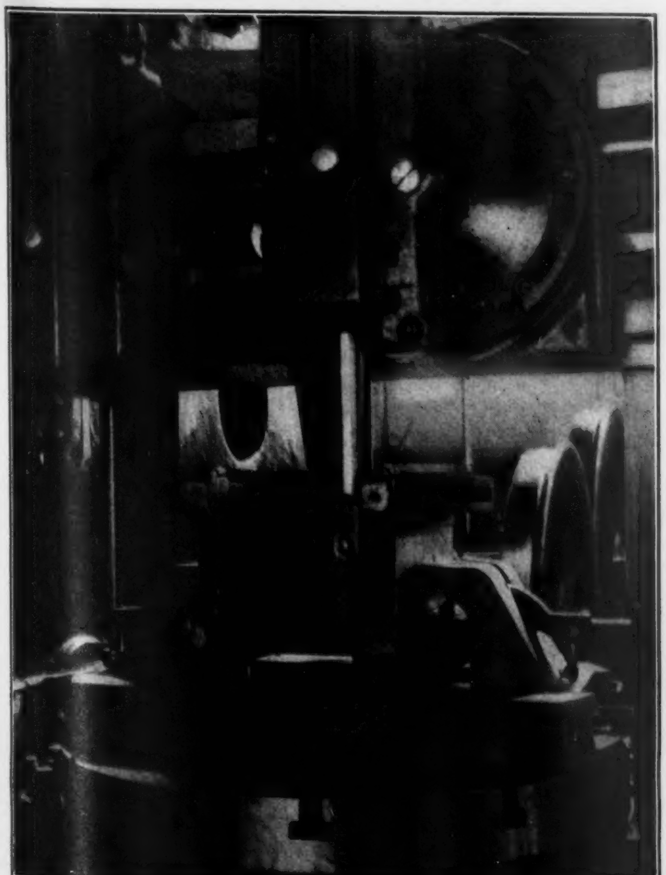


FIG. 3.

left-hand brass nuts are in the base of the chuck jaws easily accessible in case of replacement and repair. As this whole arrangement is self-contained, removing and replacing it does not affect its accuracy in the slightest degree, and with equal advantage rough box castings can be handled for first machining, facing sides, dovetailing for babbitt grooves, etc.

To the reader the question may arise of handling and boring the cellars, journal clearance, etc. In figure 3 shows the cellar removed or rather purposely omitted as an advantage in showing up view of the boring bar—also the practical advantage has proven more satisfactory in handling the cellar boring on horizontal bar; having previously tried the cellars in position, depth of cut is easily located and tools used more suited to the different metals.

PECULIARITIES OF WHITE METAL ALLOYS

Comparatively little has been written about babbitt metals and white metal alloys, and that little is of such a character and so detached that only the experienced can extract any value from such articles and they give none of the finer points of manufacturing so essential to the production of genuinely good bearing metals. The high-grade commercial alloys have been developed gradually, and the secrets which impart to such metals their special value are carefully guarded and it is a mistaken idea that maximum results can be obtained, merely by melting down and mixing together various proportions of metals.

The best grade of solder is composed of equal parts of tin and lead. The fusing point of tin is 446 degrees Fahr. and of lead 619 deegrees Fahr., and the mean arithmetic fusing point of this mixture is 532 degrees Fahr., but as a matter of fact solder fuses at 370 degrees Fahr., which is much under even the lowest constituent of the mass. Despite the general knowledge of this fact, babbitts are frequently found closely approximating solder formulas, and although such metals will stand the ordinary physical tests for hardness, toughness, peening, etc., they are highly susceptible to frictional heat, and therefore are liable to soften and squash out of the box at a comparatively low temperature.

Spelter alloys (white brass) also present some peculiar features. When in a cold state it gives every indication of being an ideal bearing metal, being hard, tough, ductile, and peens perfectly, but woe betide the bearing lined with this mixture when the temperature reaches around 300 degrees Fahr. When it does let down there are no halfway measures about it, as it loses all atomic cohesion, and it can be pulverized with a lead pencil. This peculiar quality of white brass is generally known, and its use is usually confined to bearings where the service is intermittent, and not likely to create much frictional heat. It has also had a certain vogue on steamships where the temperature can be kept down with streams of water running over the bearings.

Perhaps the most remarkable of all the white metal alloys is the mixture used for fusible plugs. It is composed of bismuth, 507 degrees Fahr.; cadmium, 610 degrees Fahr., and tin, 446 degrees Fahr., and the mean arithmetic fusing point is higher even than solder, but if this composition were moulded into say the form of a spoon, it would give evidence in weight, strength and appearance of being a useful table implement, and yet it would melt in hot water. The knowledge of many such facts, and then some more, are requisite as a preliminary start to equip a person to produce even a most ordinary grade of babbitt metal that is properly made and evenly balanced. A person must at least know what metals have affinity, and those that are antagonistic, and to what extent metals influence each other and will properly alloy. When it comes to the production of a high-grade anti-friction metal like Magnolia, it requires special fine points carried out with the precision of a druggist prescription by specially trained and skilled workmen, and the mere knowledge of the formula would in itself be of little use in imparting the special characteristics and value of that product.